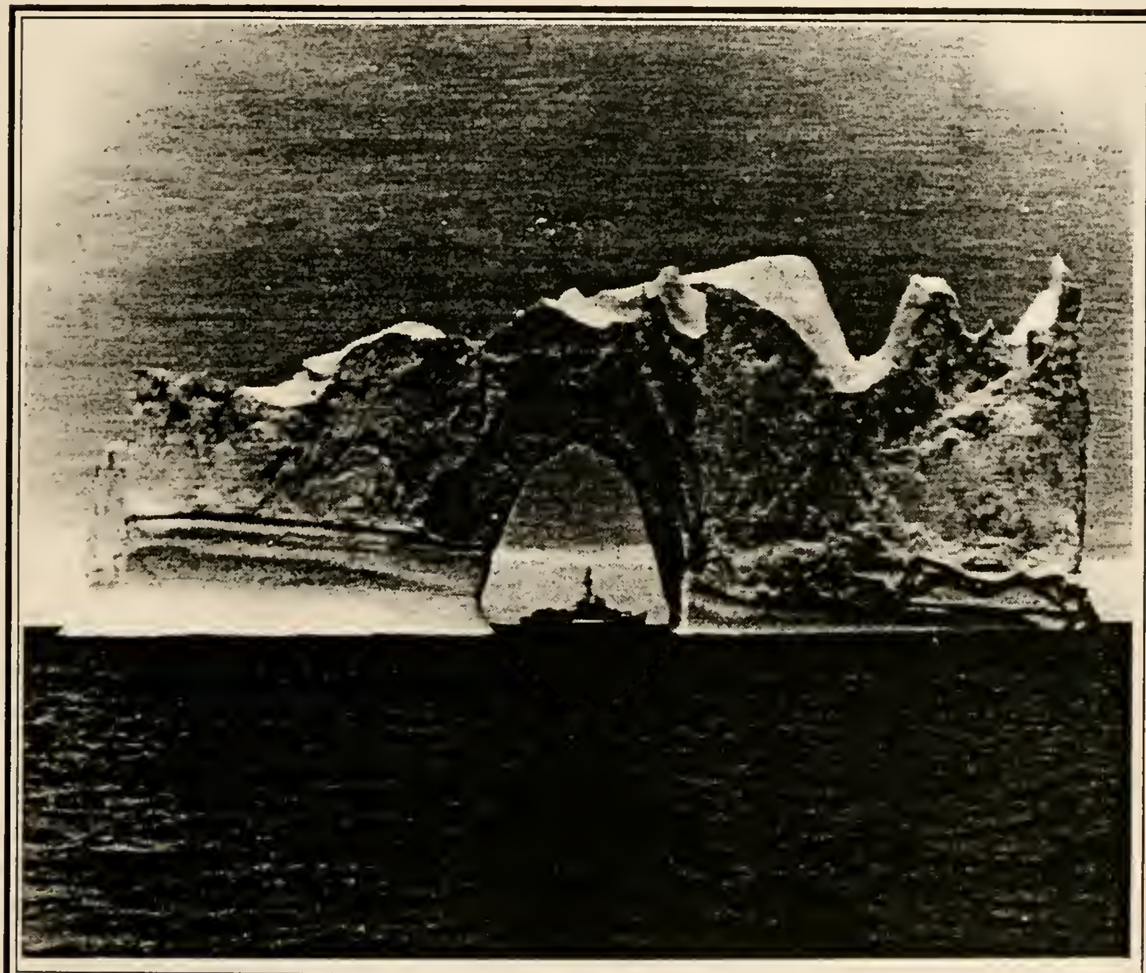
U. S. Department
of Transportation
**United States
Coast Guard**

Report of the International Ice Patrol in the North Atlantic



1996 Season
Bulletin No. 82
CG-188-51

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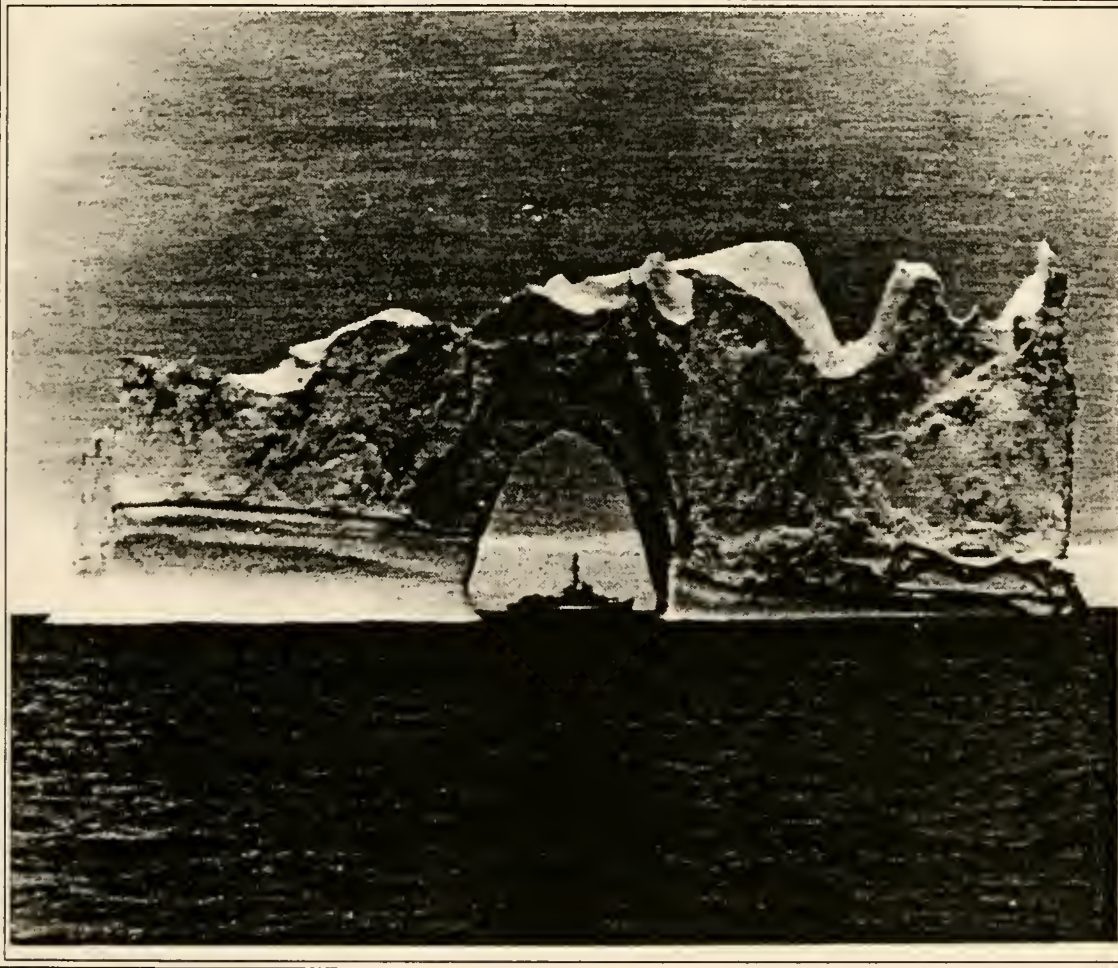

1996 Season
Bulletin No. 82
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Bulletin No. 82

REPORT OF THE INTERNATIONAL ICE PATROL IN THE NORTH ATLANTIC

Season of 1996

CG-188-51

Forwarded herewith is Bulletin No. 82 of the International Ice Patrol, describing the Patrols's services, ice observations and conditions during the 1996 season.

R. A. ROOTH
Commander, U. S. Coast Guard
Chief, Icebreaking Division

International Ice Patrol 1996 Annual Report

Contents

Introduction

This is the 82nd annual report of the International Ice Patrol (IIP). It contains information on Ice Patrol operations, environmental conditions, and ice conditions for the 1996 IIP season. The U.S. Coast Guard conducts the Ice Patrol in the North Atlantic under the provisions of U.S. Code, Title 46, Sections 738, 738a through 738d, and the International Convention for the Safety of Life at Sea (SOLAS), 1974. The IIP is supported by 17 member nations (Appendix A). It was initiated shortly after the sinking of the RMS TITANIC on April 15, 1912 and has been conducted seasonally since that time.

Commander, International Ice Patrol (CIIP) is under the operational control of Commander, Coast Guard Atlantic Area. CIIP directs the Ice Patrol from its Operations Center in Groton, Connecticut. IIP receives iceberg location reports from ships and planes transiting its patrol area and conducts aerial Ice Reconnaissance Detachments (ICERECDETs) to survey the southeastern, southern, and southwestern regions of the Grand Banks of Newfoundland for icebergs. IIP analyzes ice and environmental data and employs an iceberg drift and deterioration model to produce twice-daily iceberg warnings, which are broadcast to mariners as ice bulletins and facsimile charts. IIP also responds to requests for iceberg information. IIP's ICERECDETs were based in St. John's, Newfoundland, Canada during the 1996 season.

Vice Admiral James M. Loy was Commander, Atlantic Area until June, 1996, when he was relieved by Vice Admiral Kent H. Williams. CDR Ross L. Tuxhorn was Commander, International Ice Patrol.

Summary of Operations, 1996

The 1996 IIP year (October 1, 1995 - September 30, 1996) marked the 82nd anniversary of the International Ice Patrol, which was established February 7, 1914. IIP's operating area is enclosed by lines along 40°N, 52°N, 39°W and 57°W (Figure 1).

IIP's first preseason aerial ICERECDET of the year departed on January 23. The 1996 IIP season was opened on March 15 and from this date until July 17, 1996 an ICERECDET operated from Newfoundland every other week. The season officially closed on July 22, 1996.

IIP's Operations Center in Groton, Connecticut analyzed the iceberg sighting information from the ICERECDETs, ships, Canadian Ice Services (CIS) sea ice/iceberg reconnaissance flights, and other sources. Air reconnaissance, consisting of Coast Guard (IIP), Other Air Recon, and CIS was the major source of iceberg sighting reports this season, accounting for 61.9% of the icebergs sighted in 1996 (Table 1). Ships provided 21.0% of the iceberg sightings received by IIP in 1996. Their continued active participation indicates the value that they place on IIP's service. In 1996, 243 ships of 40 different nations provided ice information to IIP. This demonstrates the number of nations using the services of, and contributing to, IIP far exceeds the 17 member nations underwriting IIP under SOLAS 1974. Appendix B lists the ships that provided iceberg sighting reports, including reports of radar targets. In Appendix B, a single report may contain multiple targets.

The largest contributor of air reconnaissance reports was Provincial Airlines Limited (PAL). Their reports accounted for nearly all of the category "Other Air Recon" on Table 1. PAL is a private company that provides aerial reconnaissance services for the Canadian Department of Fisheries and Oceans (DFO) year round, and for the Atmospheric Environment Service of Environment Canada (AES) June through December. DFO flights, which are designated to moni-

Table 1
Sources of All Sightings Entered into IIP's Drift Model

Sighting Source	Percent of Total
Coast Guard (IIP)	22.2
Other Air Recon	27.0
Canadian AES	12.7
BAPS	17.1
Ships	21.0

Table 2
Sources of Limit-Setting Icebergs

Sighting Source	Percent of Total
Coast Guard (IIP)	61
Other Air Recon	7
Canadian AES	8
BAPS	2
Ships	20
Other	2

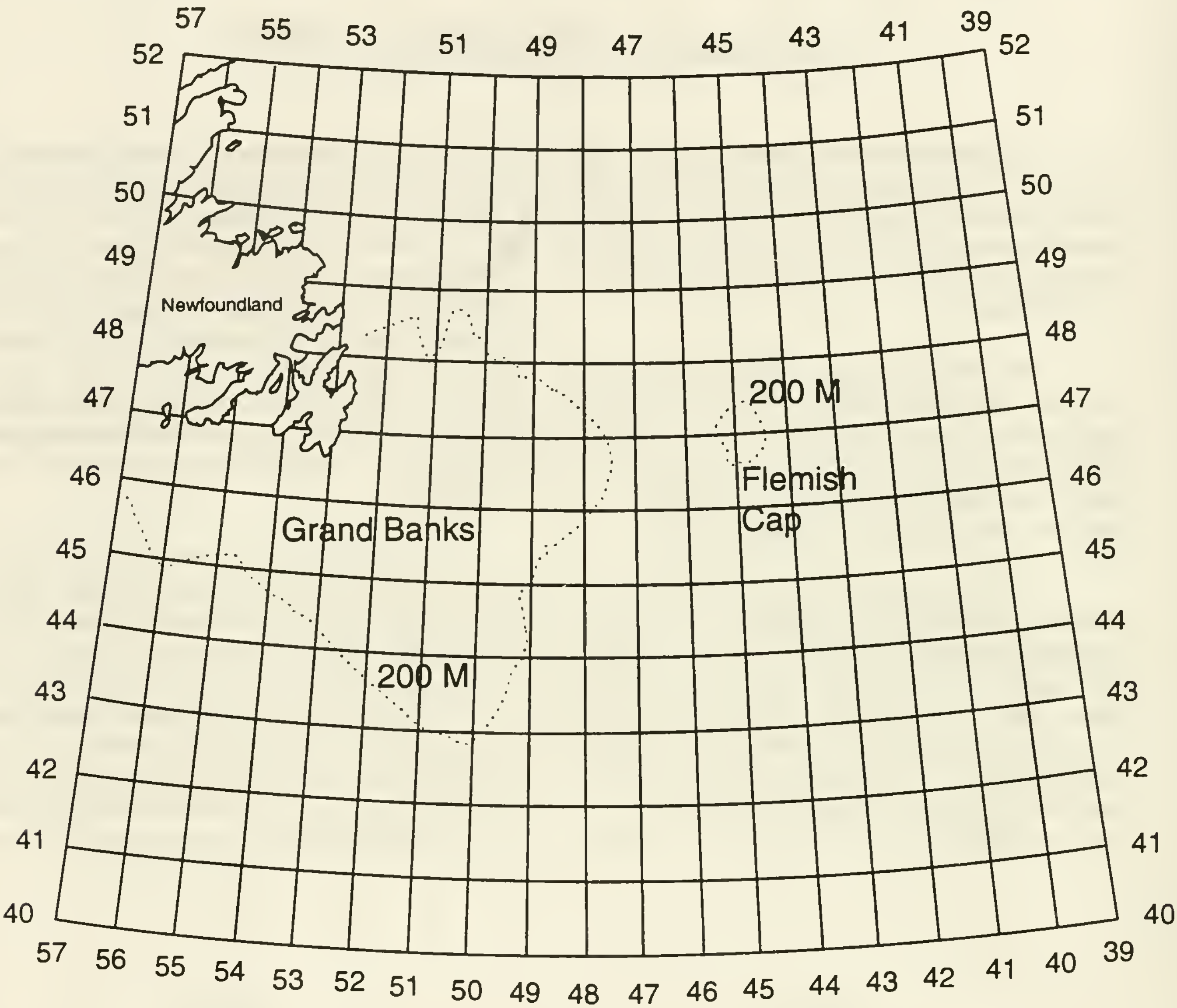

Figure 1
International Ice Patrol's Operation Area showing bathymetry of the Grand Banks of Newfoundland

tor the activities of fishing vessels, frequently carry them to areas with high iceberg concentrations. The next largest contribution to the air reconnaissance total was from IIP ICERECDETs. IIP flights concentrate on defining the boundaries of the iceberg distribution. These are typically areas of low iceberg concentration. Table 2 shows the important contribution of IIP reconnaissance in determining the limits of all known ice (LAKI). The attributes of the individual icebergs that set the LAKI are described in Appendix C. BAPS sightings are icebergs detected north of 52°N primarily by AES reconnaissance. These are passed to IIP by AES as the icebergs are predicted to have crossed into the Ice Patrol operating area. AES acquired and relayed to IIP iceberg information obtained during sea ice reconnaissance flights and a few flights dedicated solely to iceberg reconnaissance.

During 1996, the IIP Operations Center received a total of 3902 target sightings within its operations area which were entered into IIP's drift

model. This is only about half of the 7962 target sightings during 1995. The 3902 targets entered into IIP's drift model do not represent all of the targets reported to IIP. Sightings of targets outside IIP's Area of Responsibility (AOR) were not entered into the model. Most of these were far to the north of IIP's AOR, in areas not covered by IIP's model. Coastal iceberg sightings were also screened, and only those with the potential to drift into the trans-Atlantic shipping lanes were entered into the IIP model.

Table 3 includes icebergs detected south of 48°N plus the number of icebergs which were predicted to drift across 48°N for each month of 1996. During the 1996 ice year, an estimated 611 icebergs drifted south of 48°N; whereas, during 1995, 1432 icebergs had drifted south of 48°N.

Table 3
Number of Icebergs South of 48°N

Number of Icebergs South of 48°N during 1996

Month	Number
OCT	0
NOV	0
DEC	0
JAN	0
FEB	0
MAR	4
APR	297
MAY	187
JUN	108
JUL	14
AUG	1
SEP	0
Total	611

IIP classifies the severity of the ice seasons based on the historic iceberg counts of its entire 82 year history. Ice years with fewer than 300 icebergs crossing 48°N are defined as light ice years; those with 300 to 600 crossing 48°N as moderate; and those with more than 600 crossing 48°N as extreme. 1996 was at the lower end of the "extreme" classification, and in reality was a "moderate" year for iceberg conditions.

The 1996 season was the fourth year that IIP used its iceberg Data Management and Prediction System (DMPS). This system, which is nearly identical to the iceBerg Analysis and Prediction System (BAPS) used at the Canadian Ice Centre, Ottawa, combines an iceberg drift model with a deterioration model. The model uses wind, ocean current, and iceberg size data to predict the movement and deterioration of all ice bergs entered into DMPS. The drift prediction model uses a new historical current data base (Murphy, Viekman and Channel, 1996), which is modified weekly using satellite-tracked ocean drifting buoy data, thus taking into account local, short-term, current fluctuations. Murphy andAnderson (1985) described and evaluated the drift model.
The iceberg deterioration model uses daily sea surface temperature and wave height information from the U.S. Navy Fleet Numerical Meteorology and Oceanography Center (FNMOC) to predict the melt of icebergs. Anderson (1983) and Hanson (1987) described the IIP deterioration model in detail.

Fourteen satellite-tracked ocean drifting buoys were deployed to provide current data for IIP's iceberg drift model during the 1996 season. The buoys are similar in design to the World Ocean Circulation Experiment (WOCE) and were equipped with surface temperature sensors and a drogue centered at 50 meters. Drift data from the buoys are discussed in the IIP 1996 Drifting Buoy Atlas, which is available upon request.

During the 1996 season, IIP successfully deployed 127 Air-deployable eXpendable BathyThermographs (AXBTs), which measure temperature with depth and transmit the data back to the aircraft. Temperature data from the AXBTs were sent to the Canadian Meteorological and Oceanographic Center (METOC) in Halifax, Nova Scotia, Canada, the U.S. Naval Atlantic Meteorology and Oceanography Center (NLMOC) in Norfolk, Virginia, and FNMOC for use as inputs into ocean temperature models. IIP directly benefits from AXBT deployments by having improved ocean temperature data provided to its iceberg deterioration model. IIP also provided weekly drifting buoy sea surface temperature (SST) and drift histories to METOC and NLMOC for use in water mass and SST analyses. Canada's Maritime Command/Meteorological and Oceanographic Centre provided the AXBT probes for IIP use. IIP greatly appreciates the valuable support given by METOC for this program. The data collected significantly increases regional knowledge of circulation patterns and improves the capability to predict iceberg deterioration.

On April 15, 1996, IIP paused to remember the 84th anniversary of the sinking of the RMS TITANIC. During an ice reconnaissance patrol, two wreaths were placed near the site of the sinking to commemorate the more than 1500 lives lost.

Iceberg Reconnaissance and Communications

During the 1996 Ice Patrol year, 103 aircraft sorties were flown in support of IIP. Of these, 46 were transit flights to St. John's, Newfoundland, IIP's base of operations since 1989, and 48 were ice observation flights made to locate the southwestern, southern, and southeastern limits of icebergs. Seven logistics flights were required to support and maintain the patrol aircraft. Tables 4 and 5 show aircraft use for the 1996 ice year. Included in the total, but not shown in the Tables, are 2 sorties totaling 17.1 hours for Search and Rescue.

IIP's aerial ice reconnaissance was conducted with SLAR- and FLAR-equipped U.S. Coast Guard HC-130H aircraft. No HU-25B aircraft were used in 1996. The HC-130H aircraft used on Ice Patrol are based at Coast Guard Air Station Elizabeth City, North Carolina. The HU-25B aircraft available for Ice Patrol use are stationed at Air Station Corpus Christi, Texas.

This was the fourth operational year for the FLAR. Analysis of the SLAR/FLAR combination from 1993 and 1994 allowed IIP to increase search track spacing from 25 nautical miles (NM) to 30NM in 1995, resulting in a 20% increase in area covered without increasing trackline miles flown.

IIP schedules aerial iceberg surveys every other week rather than every week. This is due to the ability of the SLAR and FLAR to detect and differentiate icebergs in all weather, combined with use of the iceberg drift and deterioration computer model to track icebergs in-between sightings.

The HC-130H 'Hercules' aircraft has been the primary platform for Ice Patrol aerial reconnaissance since 1963, while the HU-25B

Table 4
Aircraft Usage During the 1996 Ice Year

Sorties

Transit	Patrol	Research	Logistics	Total
46	48	0	7	103

Flight Hours

Transit	Patrol	Research	Logistics	Total
128.2	292.9	0	10.9	449.1

Table 5
Iceberg Reconnaissance Sorties

Month	Sorties	Flight Hours
JAN	1	7.4
FEB	1	8.0
MAR	7	39.2
APR	10	57.7
MAY	13	74.9
JUN	9	56.1
JUL	7	49.6
TOTAL	**48**	**292.9**

has been used since 1988. The extent of the iceberg distribution throughout the entire 1996 season required the use of the HC-130H rather than the HU-25B. The total number of flight hours increased from 439.1 hours in 1995 to 449.1 in 1996. The number of sorties decreased from 106 in 1995 to 103 in 1996. The similarity in flight hours and patrol sorties in 1995 and 1996 reflects the similar geographic limits of the icebergs in both years, even though many more icebergs crossed south of 48°N in 1995.

Each day during the ice season IIP prepared and distributed ice bulletins at 0000Z and 1200Z to wam mariners of the southwestern, southem, and southeastem limits of icebergs. U. S. Coast Guard Communications Station Boston, Massachusetts, NMF/NIK, and Canadian Coast Guard Radio Station St. John's Newfoundland/VON were the primary radio stations responsible for the dissemination of the ice bulletins. In addition, the 0000Z and 1200Z ice bulletin and safety broadcasts were delivered over the INMARSAT-C SafetyNet via the AOR-W satellite. Other transmitting stations for the bulletins included METOC Halifax, Nova Scotia/CFH, Canadian Coast Guard Radio Station Halifax/VCS, Radio Station Bracknel, UK/GFE, and U. S. Navy LCMP Broadcast Stations Norfolk, Virginia/NAM, and Key West, Florida.

IIP also prepared a daily facsimile chart, graphically depicting the limits of all known ice, for broadcast at 1600Z and 1810Z daily. In addition, the facsimile chart was placed on Comsat Corp's INMARSAT-A FAXMAIL Server for receipt at sea. U. S. Coast Guard Communications Station Boston/NIK assisted with the transmission of these charts. Canadian Coast Guard Radio Station St. John's Newfoundland/VON and U. S. Coast Guard Communications Station Boston/NIK also provided special broadcasts as required.

As in previous years, International Ice Patrol requested that all ships transiting the area of the Grand Banks report ice sightings, weather, and sea surface temperatures via Canadian Coast Guard Radio Station St. John's/VON, U. S. Coast Guard Communications Station Boston/NIK, or INMARSAT-C or -A using code 42. Response to this request is shown in Table 6. Appendix B lists all contributors. IIP received relayed information from the following sources during the 1996 ice year: Canadian Coast Guard Marine Radio Station St. John's/VON; Canadian Coast Guard Vessel Traffic Centre/Ice Operations St. John's; Ice Centre Ottawa; Canadian Coast Guard Marine Radio Station Halifax, Nova Scotia/VCS; ECAREG Halifax, Nova Scotia; U. S. Coast Guard Communications and Master Station Atlantic, Chesapeake, Virginia; U. S. Coast Guard Atlantic Area Command Center; and U. S. Coast Guard Automated Merchant Vessel Emergency Response/Operations Systems Center, Martinsburg, WV. Commander, Intemational Ice Patrol extends a sin-

Table 6
Iceberg and Sea Surface Temperature (SST) Reports

Number of ships furnishing SST reports	45
Number of SST reports received	372
Number of ships furnishing ice reports	243
Number of ice reports received	899
First Ice Bulletin	151200Z MAR 96
Last Ice Bulletin	221200Z JUL 96
Length of Season (days)	130

cere thank you to all stations and ships which contributed reports. The vessel providing the most reports was the HMCS Toronto, a Canadian Forces vessel.

Discussion of Ice and Environmental Conditions

Background

The offshore branch of the Labrador Current is the main mechanism transporting icebergs south to the Grand Banks and the North Atlantic shipping lanes (Figure 2). Its relatively cold water keeps the deterioration of icebergs to a minimum.

Sea ice protects the icebergs from wave action, the major agent in iceberg deterioration. If sea ice extends to the south and over the Grand Banks of Newfoundland, the icebergs will be protected longer as they drift south. When the sea ice edge retreats in the spring, large numbers of icebergs will be left behind in the vicinity of the Grand Banks. If the time of retreat of the sea ice edge is delayed by below-normal air and sea surface temperatures, the icebergs will be protected from melt longer and be expected to survive to drift farther south. In these cases a longer than normal ice season can be expected. Less southerly sea ice extent or above normal air and sea surface temperatures may result in a shorter season.

Sea ice can impede the transport of icebergs. The degree depends on the concentration of the sea ice and the size of the icebergs. The greater the sea ice concentration, the greater the effect on iceberg drift. The larger the iceberg, the less sea ice affects its drift.

The 1996 Season

Figures 3 to 10 compare the sea ice edge during the 1996 ice year to the mean sea ice edge. The mean sea ice edges were taken from Cote (1989) and represent a 25 year average (1962-1987). The ice edge (sea ice concentration $\geq 1/10$) is taken from the daily Ice Analysis from the Ice Centre, Ottawa.

Figures 11 to 19 show the Ice Patrol Limits of All Known Ice (LAKI) and the daily sea ice edge on the 15th and the last day of each month during the ice season. The ice edge is taken from the Ice Centre, Ottawa FICN2 daily product. The edge plotted is a coarse numeric representation of the daily IceAnalysis. These figures show the distribution of all icebergs and radar contacts tracked by IIP's model at the indicated times. Numerals are given for clarity for those one-degree squares where six or more targets are located.

The following is a discussion of the ice conditions, comparing those ice conditions observed and modeled in 1996 with the twenty-year IIP climatological LAKI described by Viekman and Baumer (1995).

December through March

Through the period, sea ice growth along the Labrador Coast and in East Newfoundland waters appeared to be 2-4 weeks behind normal (Figures 3-6). At the end of March, 4 icebergs were south of 48°N and the reported LAKI (Figure 12) fell between the minimum and the 75 percentile climatological LAKI for March 31. The 1996 Ice Patrol Season started on 15 March.

April

Throughout the month of April, the sea ice rapidly melted and the edge receded to the north and the Newfoundland-Labrador coastlines. IIP's LAKI was near the median

climatological LAKI for the entire month (Figures 12-13). There were 297 icebergs south of 48°N and the southern extent of the LAKI at the end of April was 42°30'N.

May

Sea ice destruction appeared to occur at an accelerated rate and by mid-month the sea ice edge was above 52°N and the Strait of Belle Isle was clear (Figure 8). The reported LAKI was located at the 25 percentile on the south and at the median climatological LAKI position on the east throughout the month (Figures 15-16). There were 187 icebergs that crossed 48°N and the southern extent of the LAKI was 41°30'N in May.

June

Remnants of sea ice persisted along the coast of Labrador (Figure 9). The IIP LAKI on 15 June (Figure 17) approximated the 25 percentile on the south limit and the median climatological LAKI at the east limit. At the end of June the reported LAKI (Figure 18) matched the median climatological LAKI. There were 109 icebergs south of 48°N.

July

The reported LAKI (Figure 19) also matched up well with the median climatological LAKI for July. There were 12 icebergs south of 48°N by the end of July. On 22 July, the Ice Patrol season concluded.

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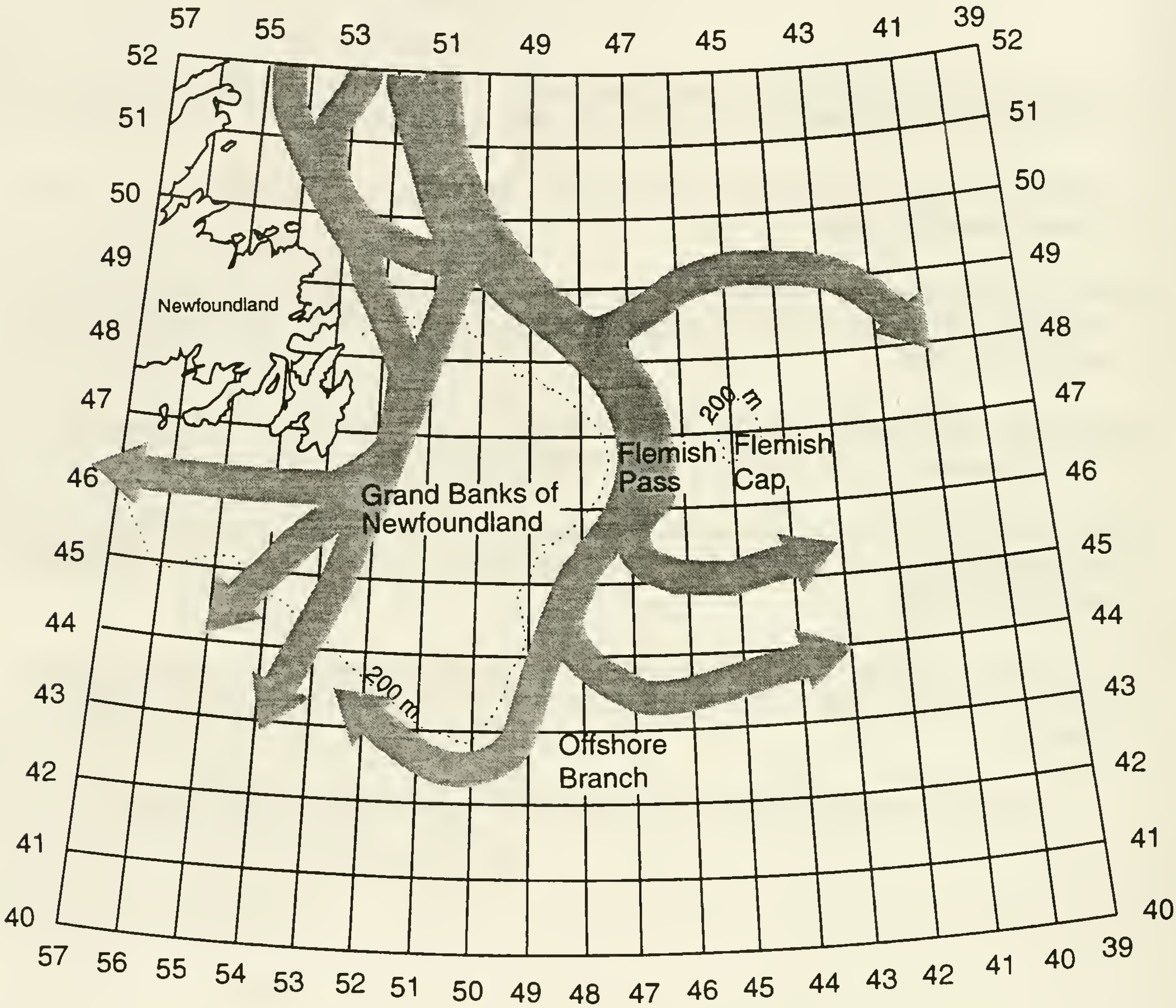


Figure 2
The Labrador Current, the main mechanism for transporting icebergs South to the Grand Banks

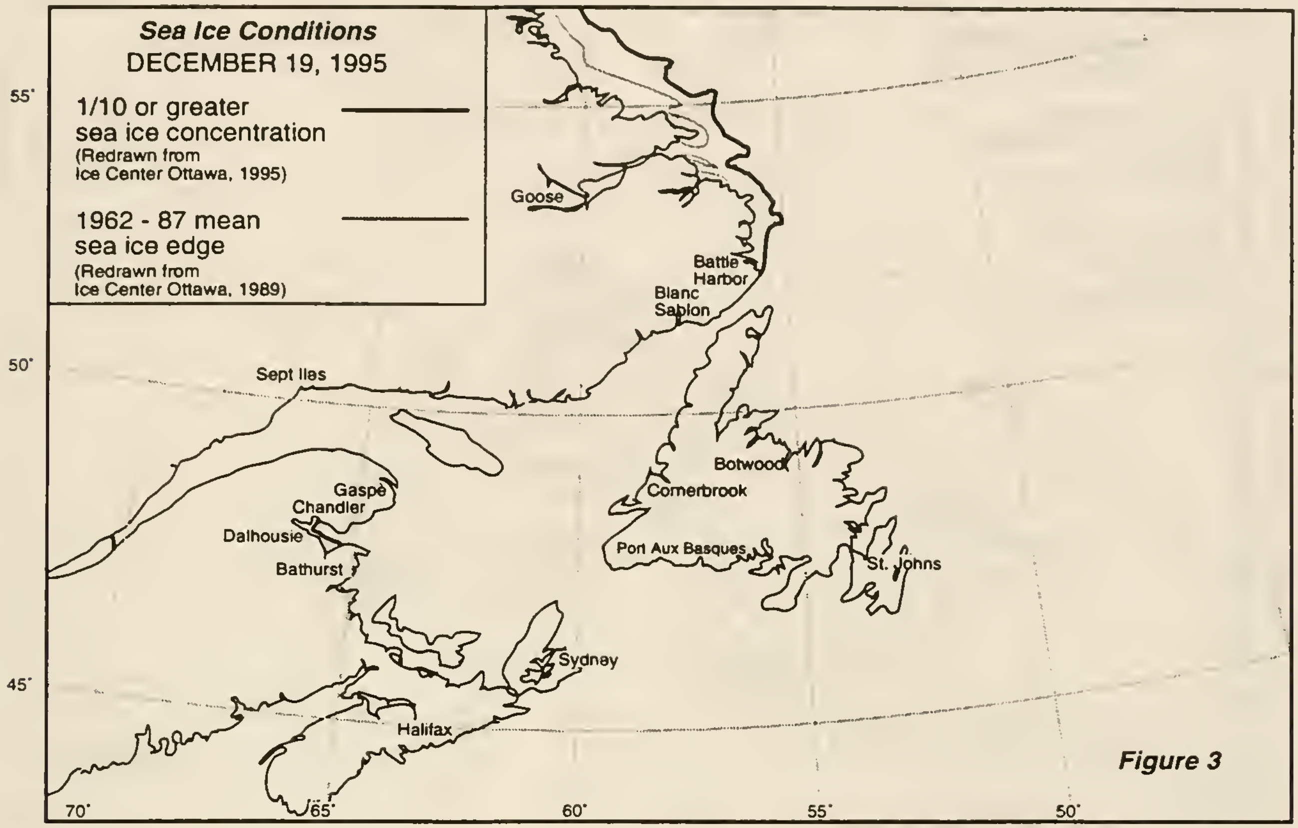


Figure 3

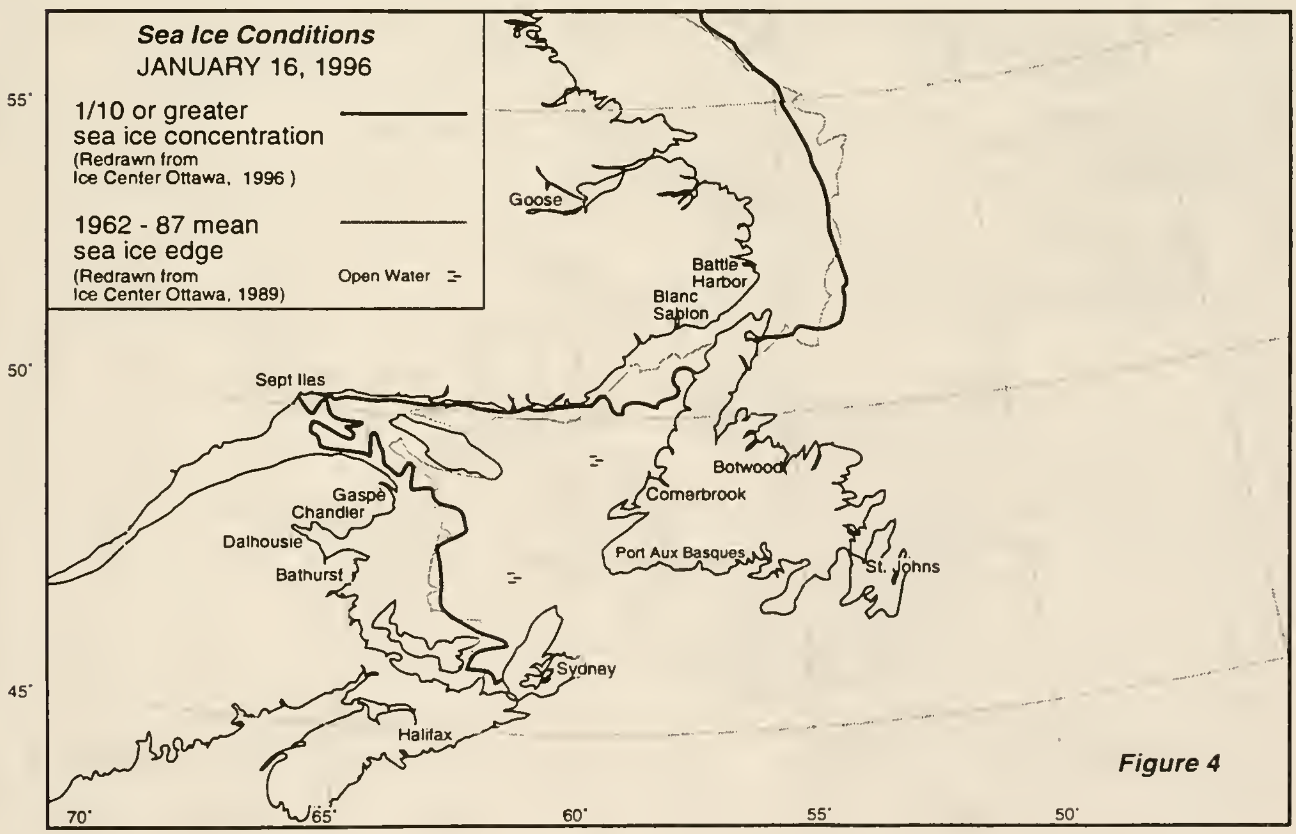


Figure 4

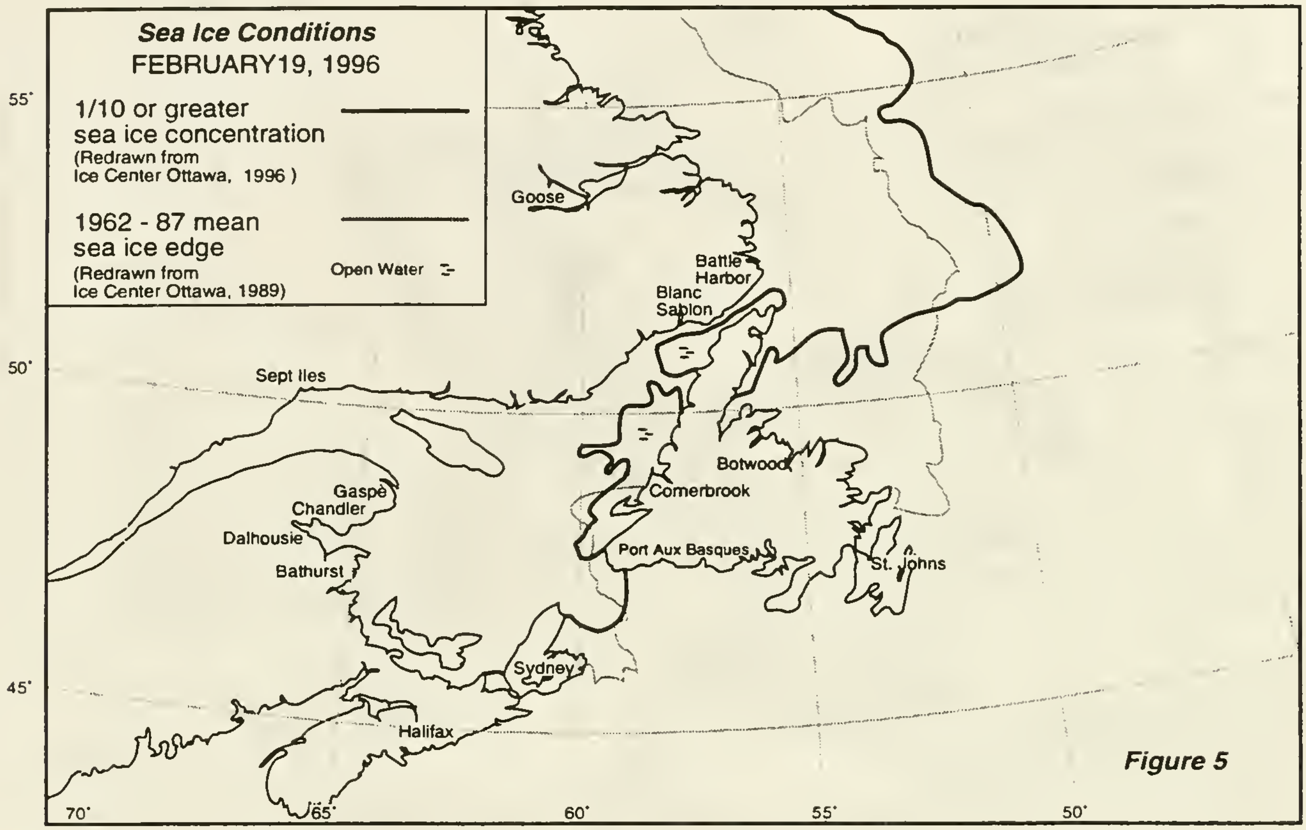


Figure 5

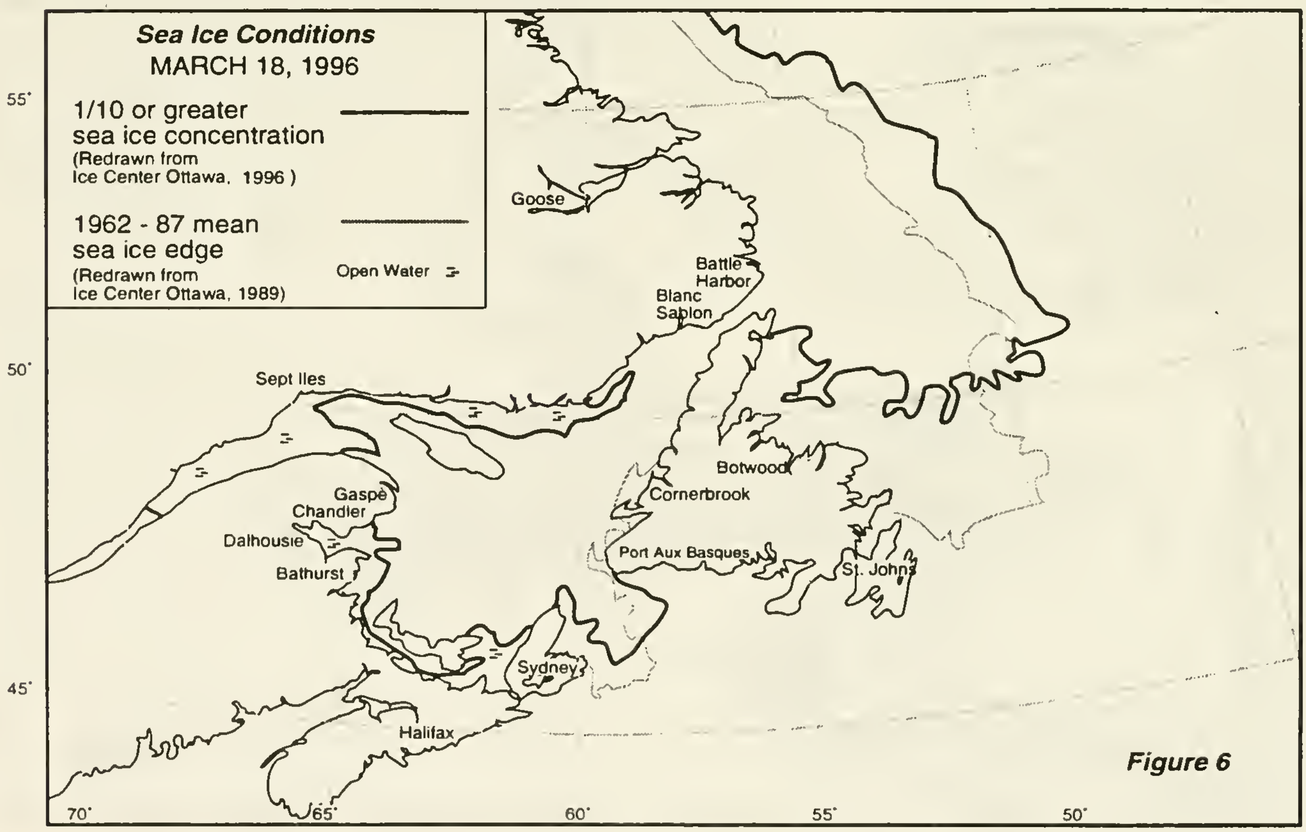


Figure 6

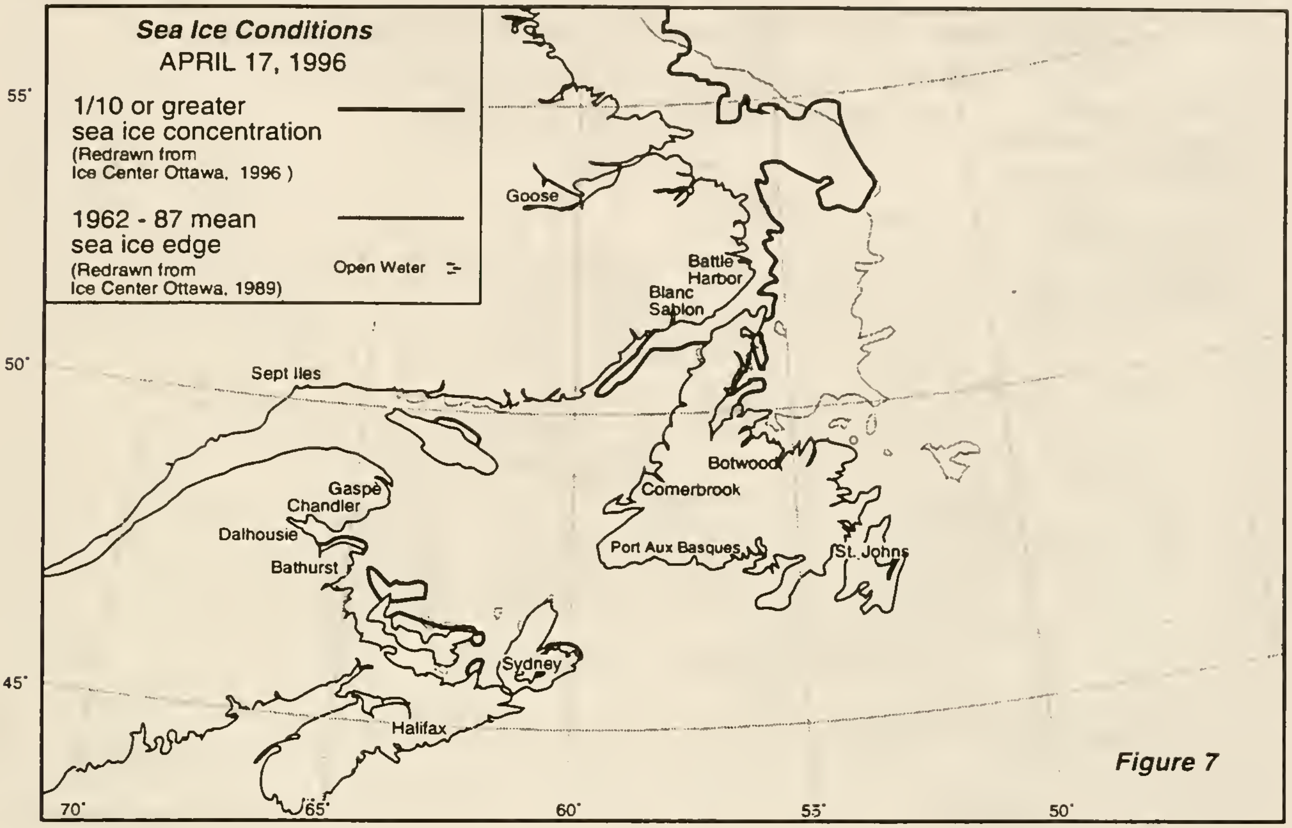


Figure 7

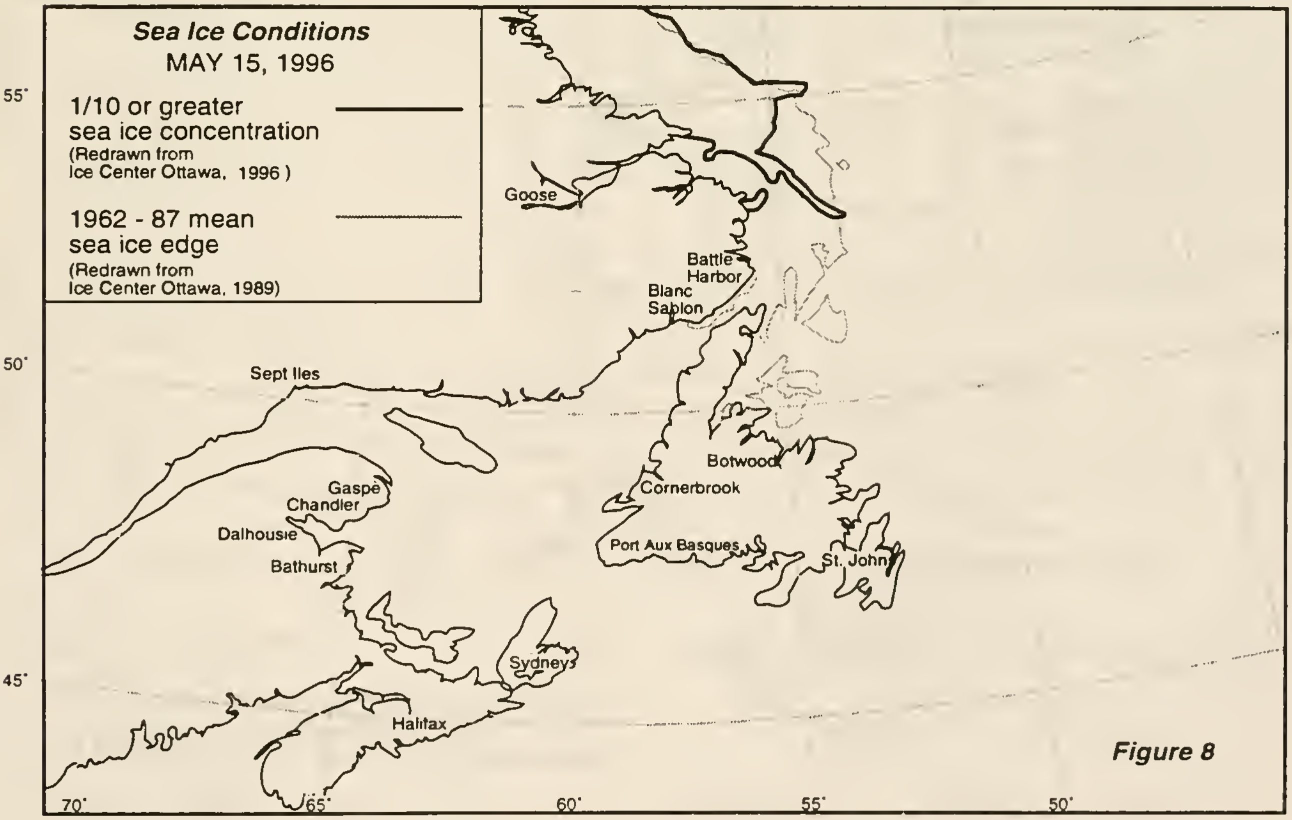


Figure 8

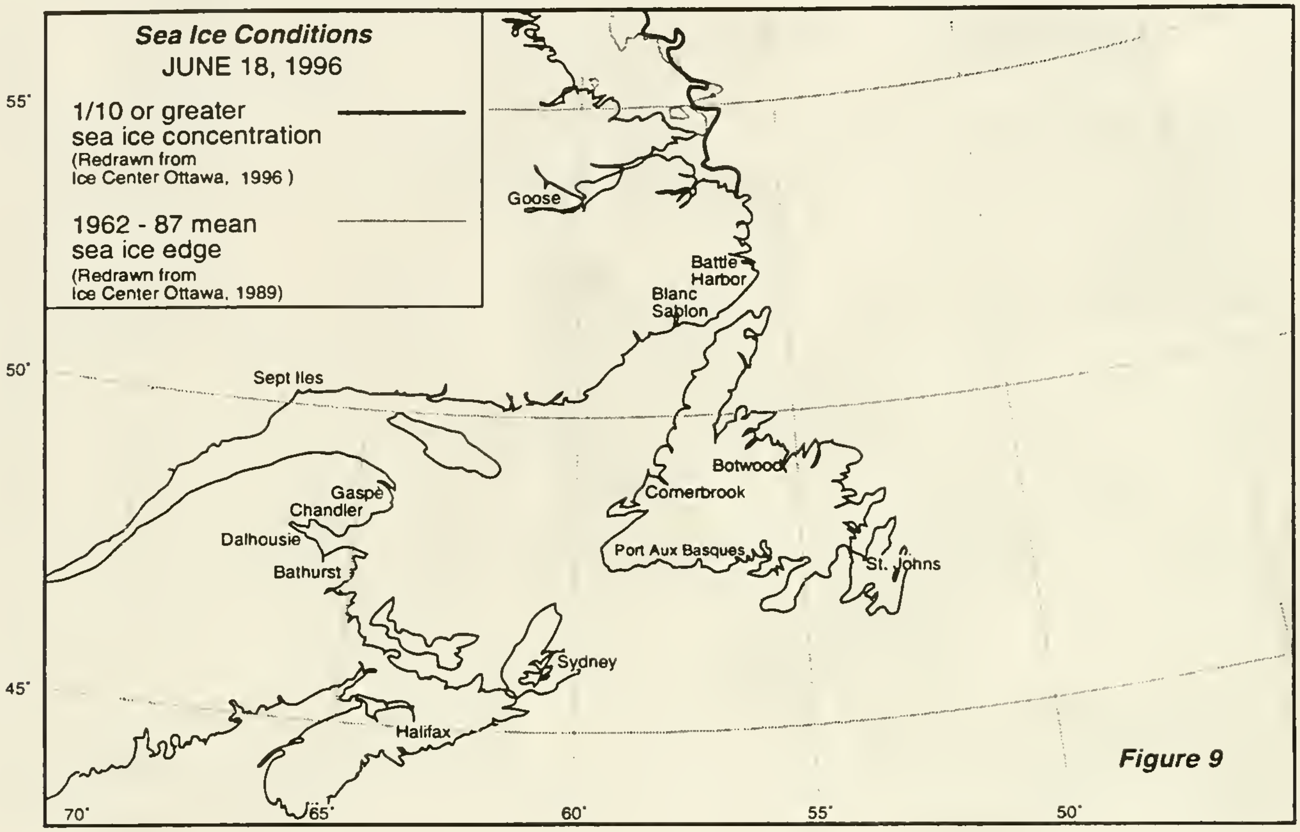


Figure 9

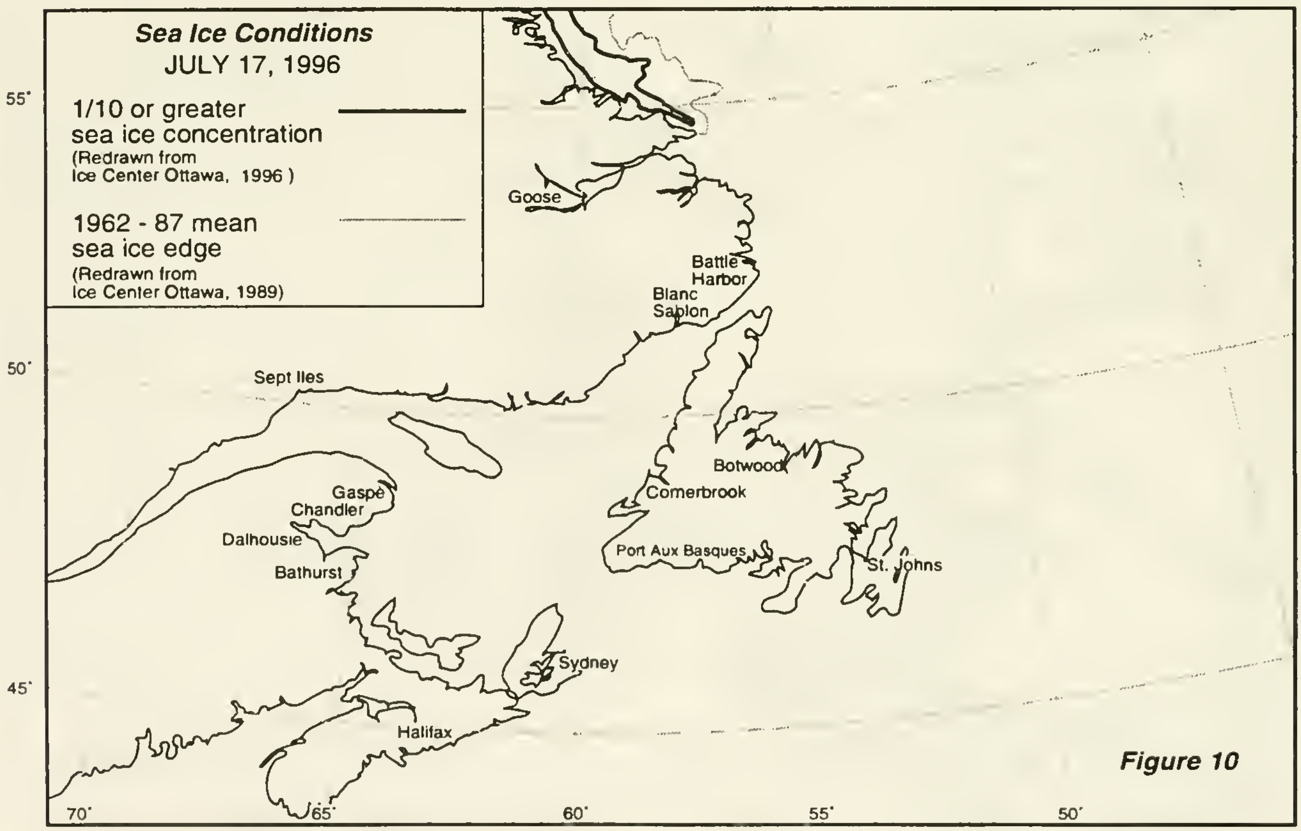
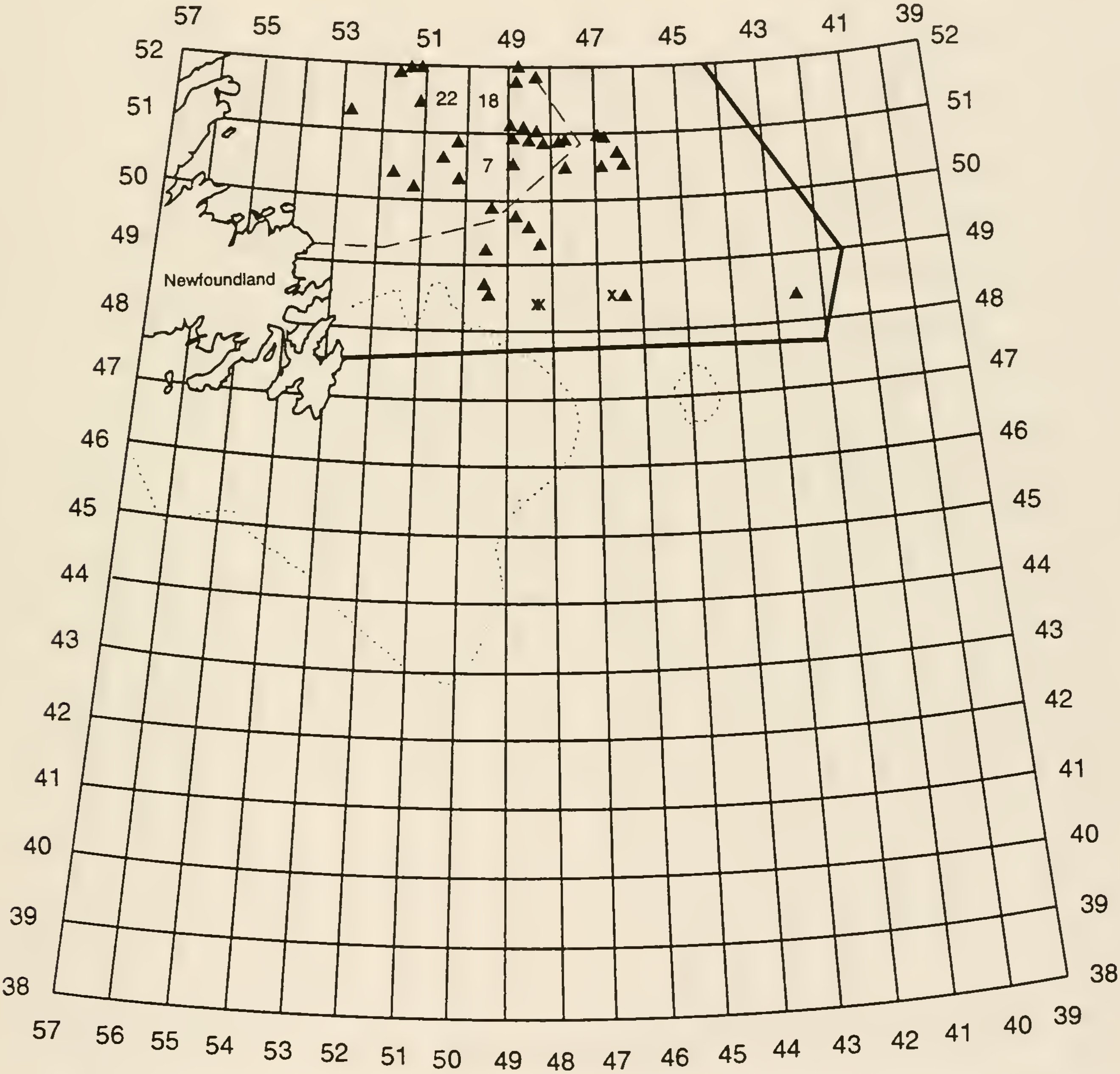


Figure 10

Figure 11

International Ice Patrol Plot for **0000 GMT 15 Mar 96** Showing Observed and Modeled Iceberg Positions and Sea Ice Edge



▲ Iceberg

X Radar Target

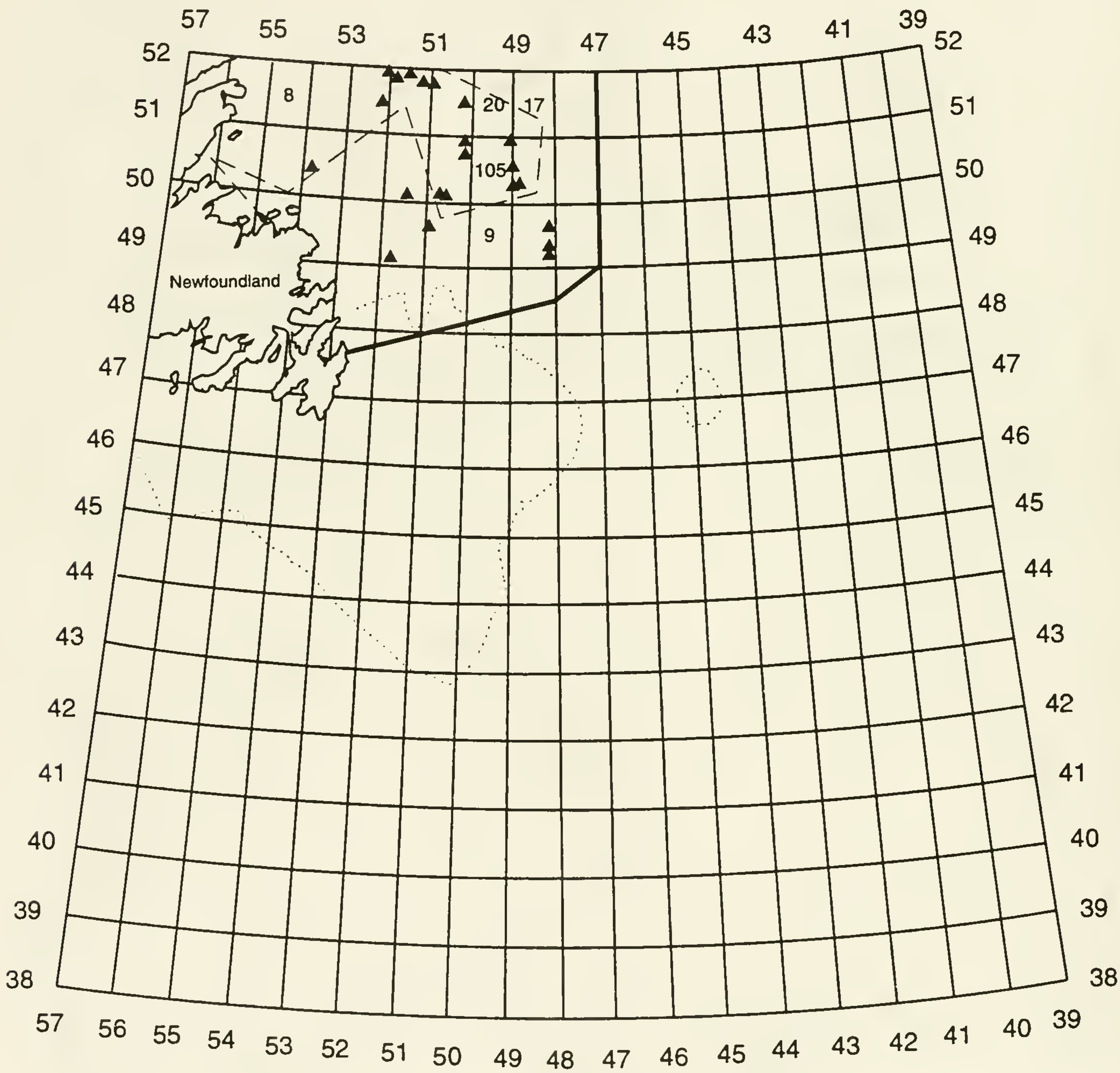
N Number of Icebergs/Radar Targets Per One Degree Rectangle
(for squares with 6 or more total iceberg/radar targets)

—— Limit of All Known Ice

– – – – Sea Ice Edge

········ 200 Meter Bathymetric Curve

Figure 12
International Ice Patrol Plot for **0000 GMT 31 Mar 96**
Showing Observed and Modeled Iceberg
Positions and Sea Ice Edge



▲ Iceberg

X Radar Target

N Number of Icebergs/Radar Targets Per One Degree Rectangle
(for squares with 6 or more total iceberg/radar targets)

Limit of All Known Ice

Sea Ice Edge

200 Meter Bathymetric Curve

Figure 13
International Ice Patrol Plot for **0000 GMT 15 Apr 96**
Showing Observed and Modeled Iceberg
Positions and Sea Ice Edge

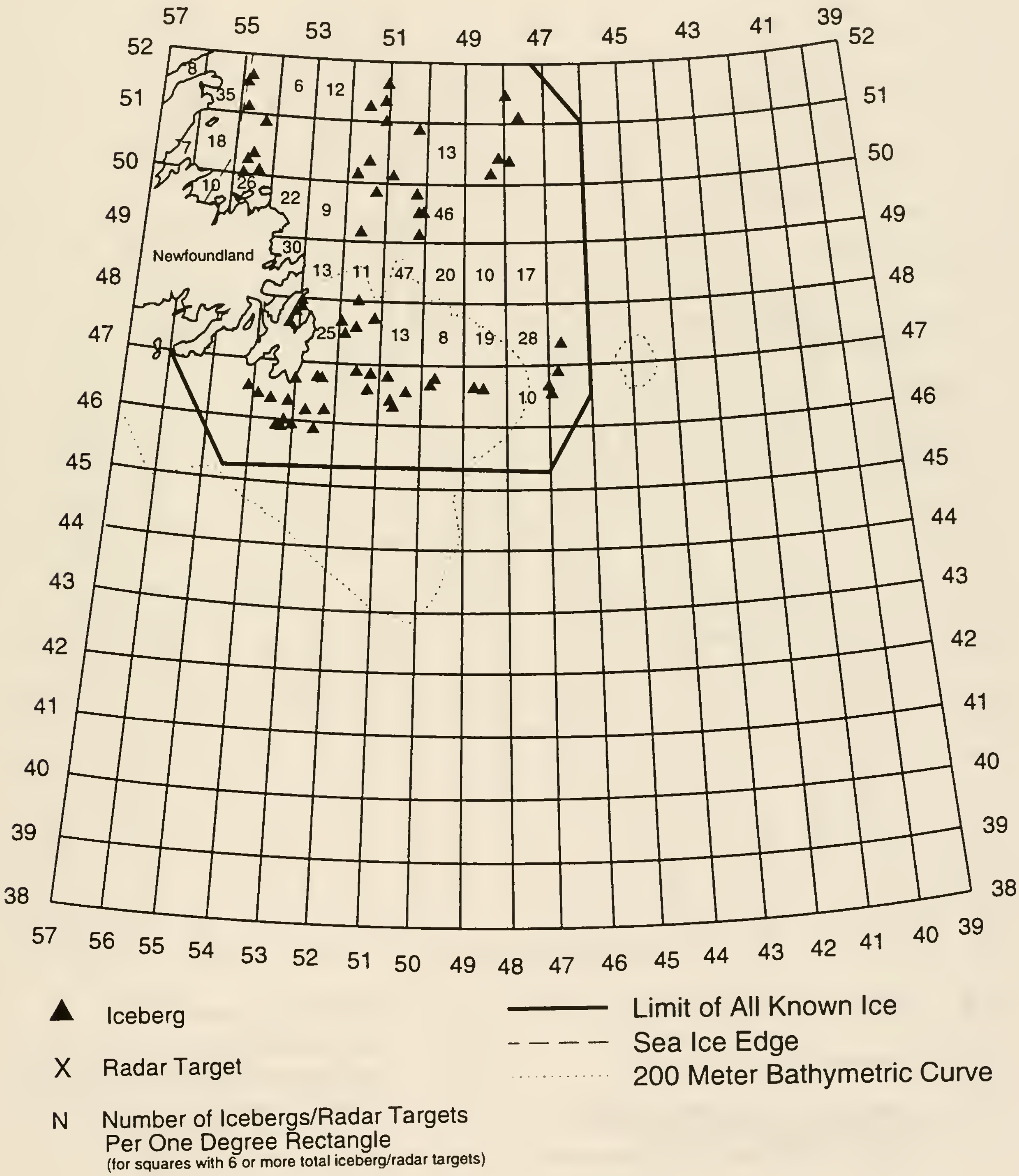
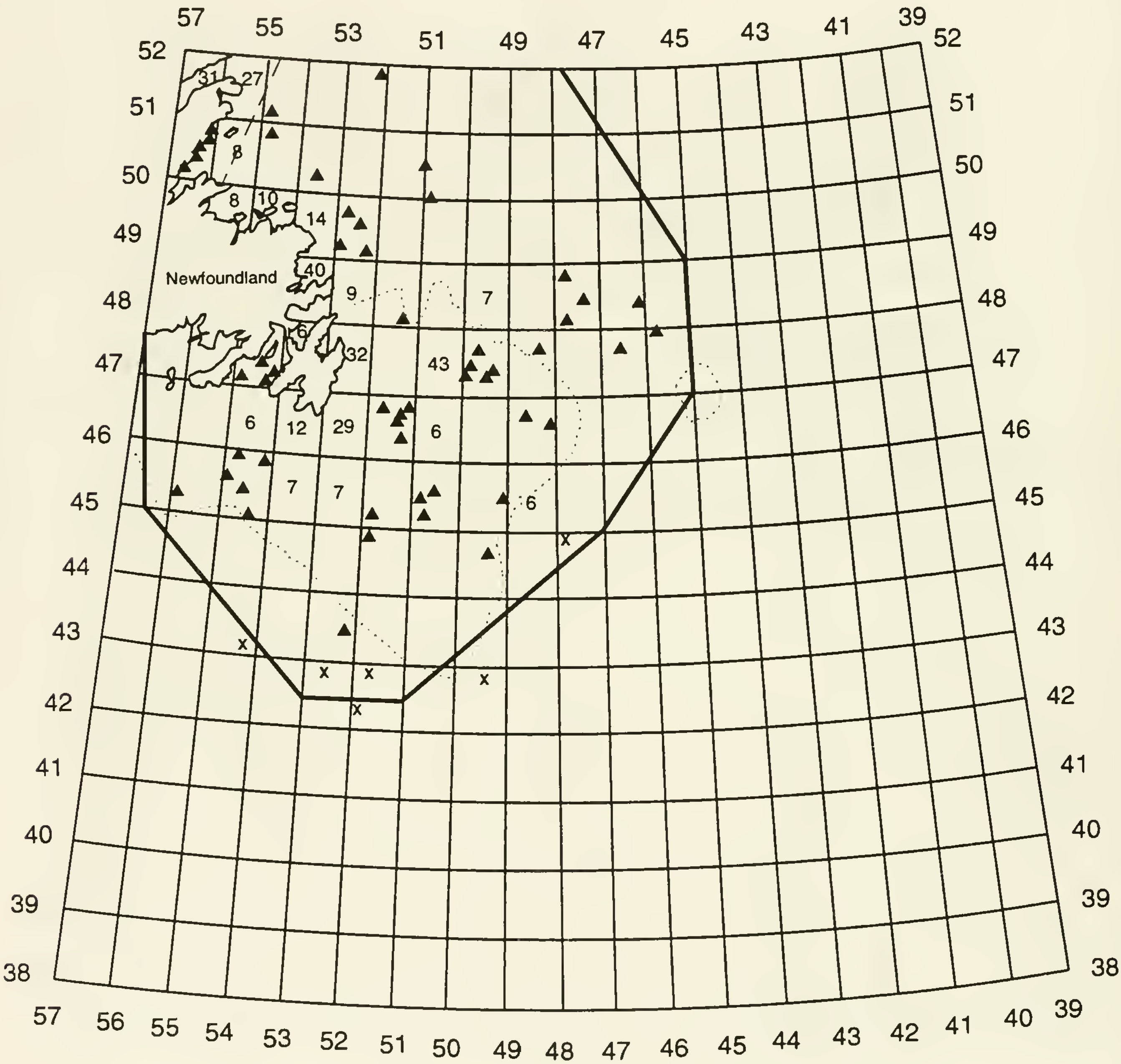


Figure 14

International Ice Patrol Plot for **0000 GMT 30 Apr 96**
Showing Observed and Modeled Iceberg
Positions and Sea Ice Edge



▲ Iceberg

X Radar Target

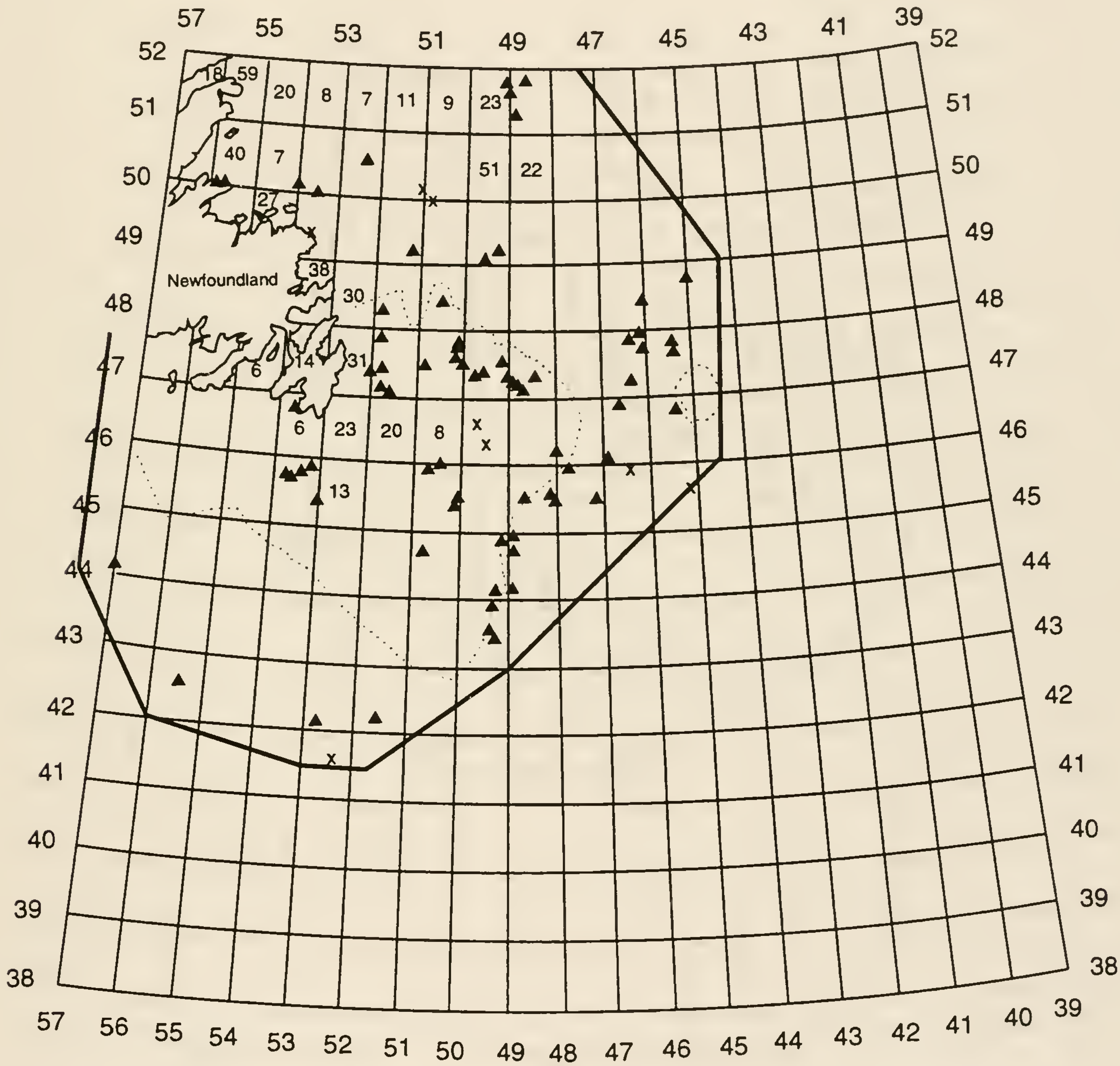
N Number of Icebergs/Radar Targets Per One Degree Rectangle (for squares with 6 or more total iceberg/radar targets)

Limit of All Known Ice

Sea Ice Edge

200 Meter Bathymetric Curve

Figure 15
International Ice Patrol Plot for **0000 GMT 15 May 96**
Showing Observed and Modeled Iceberg
Positions and Sea Ice Edge



▲ Iceberg

X Radar Target

N Number of Icebergs/Radar Targets Per One Degree Rectangle
(for squares with 6 or more total iceberg/radar targets)

——— Limit of All Known Ice

– – – – Sea Ice Edge

··········· 200 Meter Bathymetric Curve

Figure 16
International Ice Patrol Plot for **0000 GMT 31 May 96**
Showing Observed and Modeled Iceberg
Positions and Sea Ice Edge

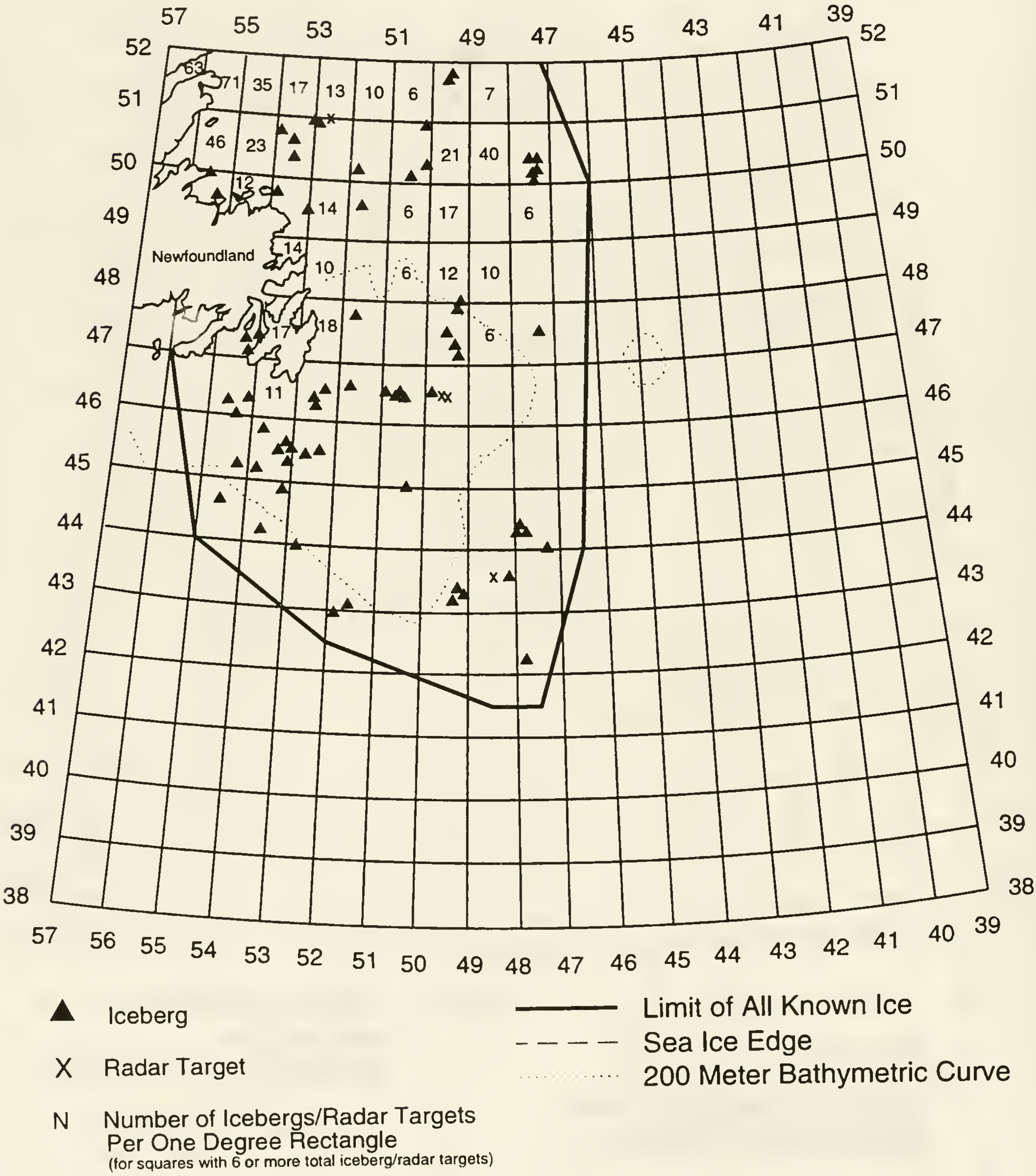
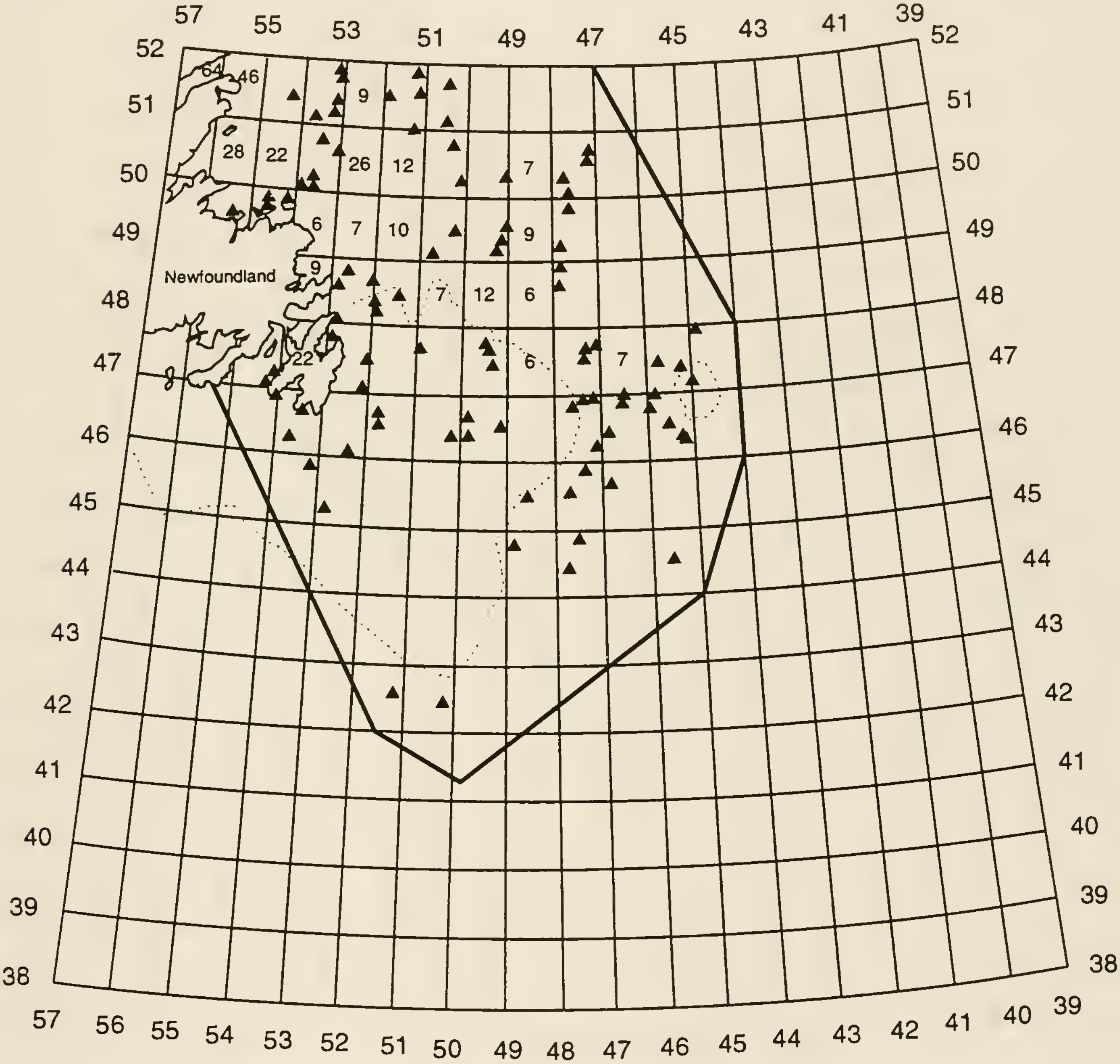


Figure 17
International Ice Patrol Plot for **0000 GMT 15 Jun 96**
Showing Observed and Modeled Iceberg
Positions and Sea Ice Edge



▲ Iceberg

X Radar Target

N Number of Icebergs/Radar Targets Per One Degree Rectangle
(for squares with 6 or more total iceberg/radar targets)

——— Limit of All Known Ice

– – – – Sea Ice Edge

.... 200 Meter Bathymetric Curve

Figure 18

International Ice Patrol Plot for **0000 GMT 30 Jun 96**
Showing Observed and Modeled Iceberg
Positions and Sea Ice Edge

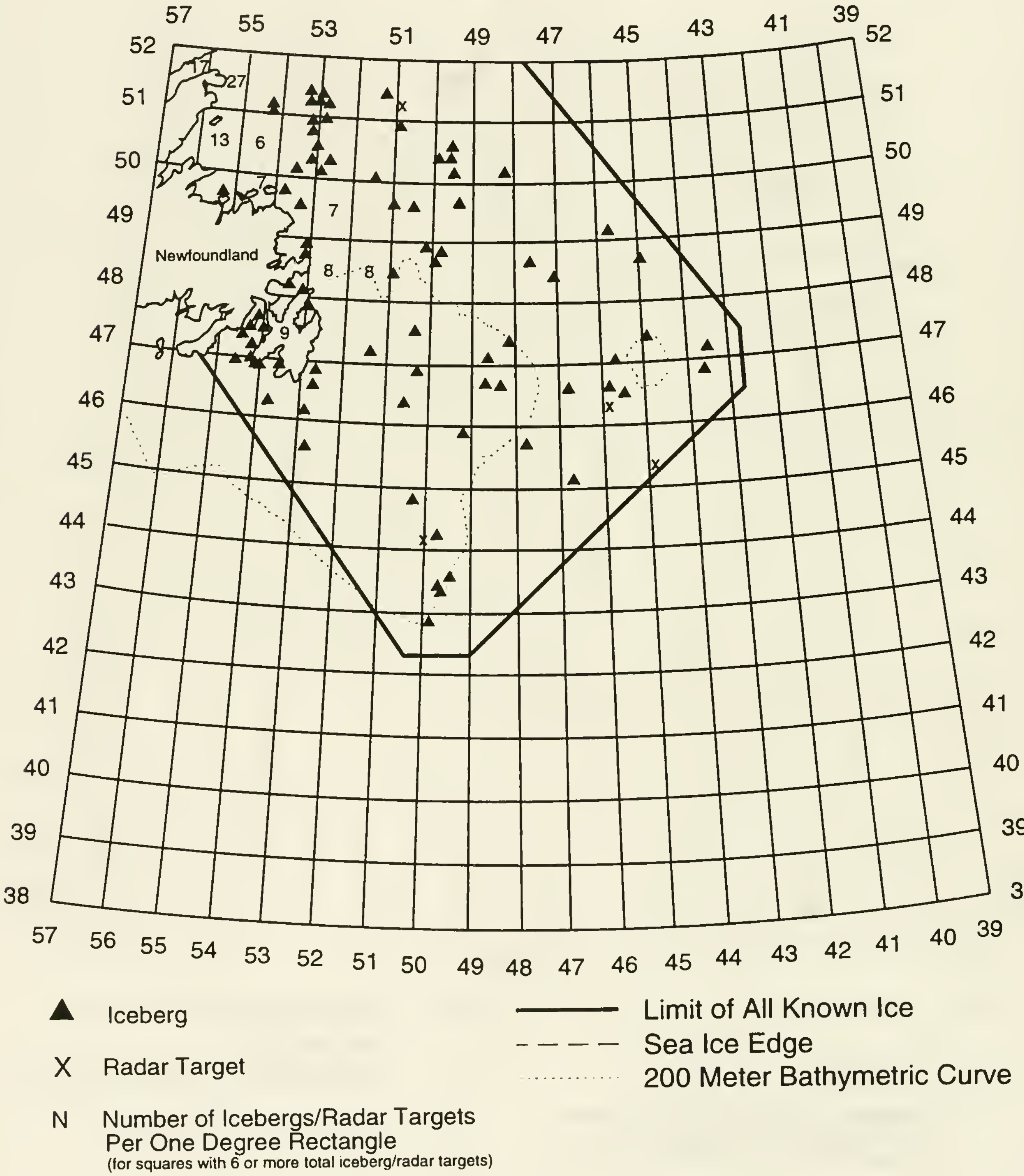
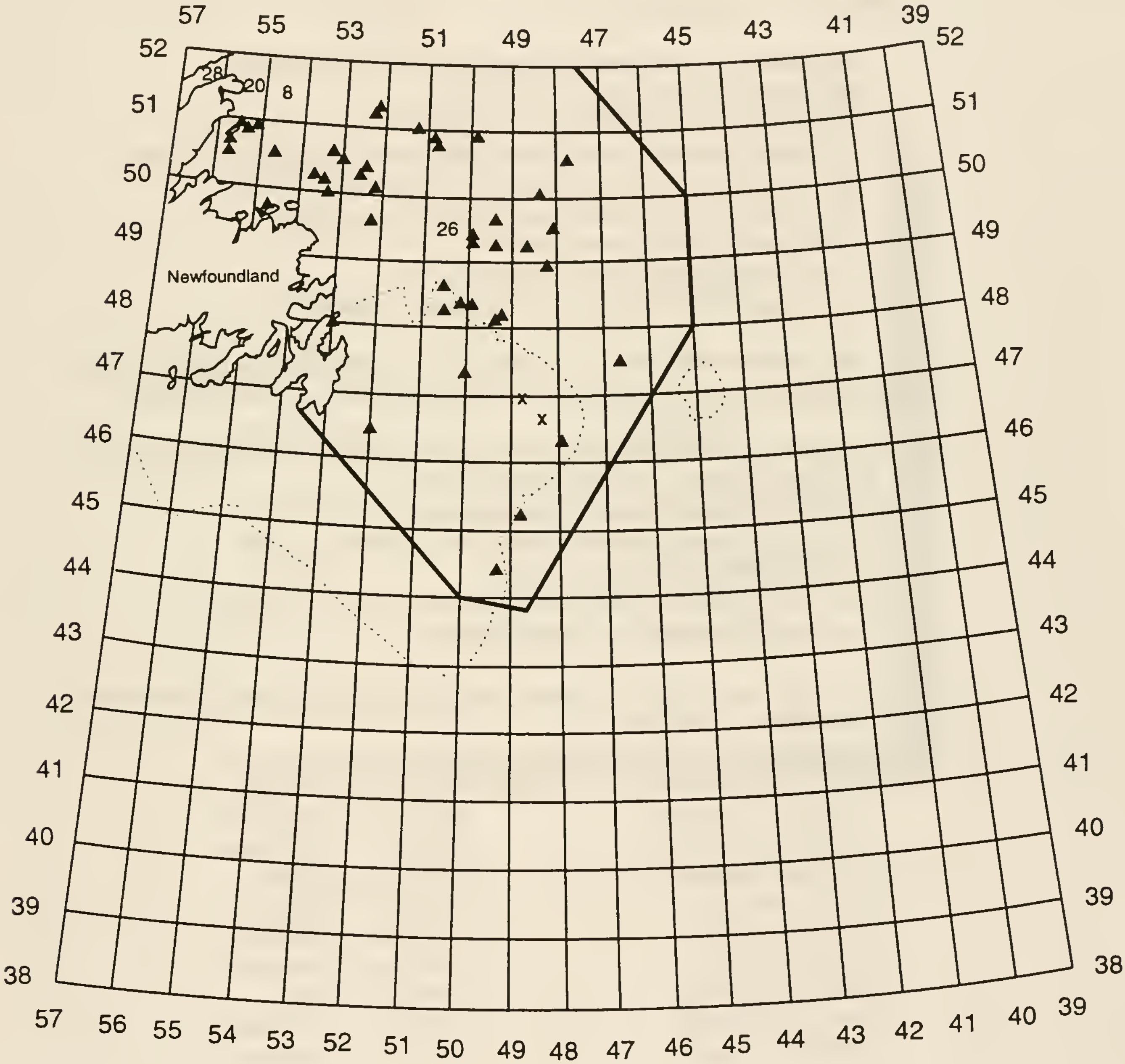


Figure 19
International Ice Patrol Plot for **0000 GMT 15 Jul 96**
Showing Observed and Modeled Iceberg
Positions and Sea Ice Edge



▲ Iceberg

X Radar Target

N Number of Icebergs/Radar Targets Per One Degree Rectangle
(for squares with 6 or more total iceberg/radar targets)

Limit of All Known Ice

Sea Ice Edge

200 Meter Bathymetric Curve

Acknowledgments

Commander, International Ice Patrol acknowledges the assistance and information provided by:

Atmospheric Environment Service of Environment Canada
Department of Fisheries and Oceans
Navy / NOAA / USCG National Ice Center
U.S. Naval Fleet Numerical Meteorology and Oceanography Center
U.S. Naval Atlantic Meteorology and Oceanography Center
U.S. Coast Guard Research and Development Center
Coast Guard Atlantic Area Staff
Coast Guard Atlantic Area Command Center
First Coast Guard District Communications Center

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CDR R. L. Tuxhorn
CDR B. E. Viekman
LCDR M. R. Hicks
Dr. D. L. Murphy
Mr. G. F. Wright
LT R. T. Haines
MSTC J. A. Fisher
YN1 C. B. Peters
YN1 S. J. Hoss

MST1 D. L. Alexander
MST1 R. A. McKnight
MST2 E. M. Fusco
MST2 L. S. Howell
MST3 B. B. Keating
MST3 M. L. McClain
MST3 T. T. Krein
MST3 H. R. Harbuck
MST3 K. D. Baumer

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Appendix A

Nations Currently Supporting International Ice Patrol

BELGIUM	NORWAY
CANADA	PANAMA
DENMARK	POLAND
FINLAND	SPAIN
FRANCE	SWEDEN
GREECE	UNITED KINGDOM
ITALY	UNITED STATES
JAPAN	GERMANY
NETHERLANDS	

Appendix B
Ship Reports

Ship Name	Ship Flag	Ice Report	SST* Report
ABITIBI CONCORD	LIBERIA	3	
ABITIBI MACADO	LIBERIA	2	
ABITIBI ORINOCO	GERMANY	1	
ACADIENNE GALE	CANADA	1	
ADA GORTHON	SWEDEN	4	
AFFINITY	SINGAPORE	2	3
AG FARQUARSON	CANADA	5	
AIVIK	CANADA	1	
ALEKSANDR SUVOROV	RUSSIA	3	
ALLOUETTE ARROW	NORWAY	5	
ALTONA	ANTIGUA/BARBUDA	3	
AMELIA DESGAGNES	CANADA	2	
AMKE	GERMANY	1	
ANAX	BAHAMAS	15	15
ANJELIERSGRACHT	NETHERLANDS	2	
ANN HARVEY	CANADA	1	
APPLEBY	BAHAMAS	2	
ARCTIC	CANADA	1	
ARCTIC SUN	CANADA	1	
ARCTIC VIKING	CANADA	1	
ARMIA LUDOWA	POLAND	1	
ASL SANDERLING	CANADA	2	
ASTRON	CANADA	1	
ATLANT 1	BAHAMAS	37	36
ATLANT 2	MALTA	27	26
ATLANTIC CLIPPER II	CANADA	1	
ATLANTIC COMPASS	SWEDEN	1	
ATLANTIC DOROTHY	CANADA	2	
ATLANTIC QUEST	CANADA	1	
BIAKH	NORWAY	3	
BIAPK	UNKNOWN	1	
BONTEGRACHT	NETHERLANDS	6	
BRISTER	CANADA	3	
CAMILLA	FINLAND	20	
CANMAR CONQUEST	UNITED KINGDOM	1	
CANMAR COURAGE	BERMUDA	6	2
CANMAR ENDEAVOR	BERMUDA	3	

* Sea Surface Temperature

Ship Name	Ship Flag	Ice Report	SST* Report
CANMAR EUROPE	BERMUDA	1	
CANMAR EXPLORER II	CANADA	1	
CANMAR GLORY	BERMUDA	2	
CANMAR SUCCESS	BERMUDA	1	
CANMAR TRIUMPH	UNITED KINGDOM	7	
CANMAR VICTORY	UNITED KINGDOM	2	
CAPE FAME	CANADA	1	
CAPE MARY	CANADA	3	
CAROLA 1	CYPRUS	1	
CAST BEAR	MTS	4	
CAST ELK	SINGAPORE	1	
CAST LYNX	MTS	13	
CATHERINE DESGAGNES	CANADA	2	
CCGS HARP	CANADA	1	
CCGS LOUIS ST. LAURENT	CANADA	2	
CHANDA	LIBERIA	2	
CHEBUCTO SEA	CANADA	1	
CHRISTINA C	DENMARK	1	
CHRISTINA I	CYPRUS	8	
CICERO	CANADA	3	
COLBY	FRENCH ANT. TERR.	8	10
CONCORDE	ST. VINCENT	10	10
CORNER BROOK	SWEDEN	17	19
COSMIC	ST. VINCENT	2	
CSS CYGNUS	CANADA	7	
CSS HUDSON	CANADA	10	
CSS PARIZEAU	CANADA	3	
DANIELLA	NETHERLANDS	2	
DOCEGULF	LIBERIA	1	
DUKE OF TOPSAIL	UNITED KINGDOM	2	
EASTERN BRIDGE	BAHAMAS	1	
EDDA	ANTIGUA/BARBUDA	2	
EIRINI L	GREECE	1	
EL KEF	TUNISIA	1	
EMERALD STAR	CANADA	4	
ERIK	ICELAND	1	
EUROPA	GERMANY	1	
EURUS	LIBERIA	1	
EXEMPLAR	HONG KONG	2	
FEDERAL FRANKLIN	LIBERIA	1	
FEDERAL NORD	NORWAY	2	

* Sea Surface Temperature

Ship Name	Ship Flag	Ice Report	SST* Report
FETISH	DENMARK	1	
FINNFIGHTER	BAHAMAS	5	
FINNSHES	CYPRUS	1	
FRONT VIEWER	SINGAPORE	7	6
GARNES	ST. VINCENT	4	3
GAUSS	GERMANY	16	13
GENERAL CABAL	PHILIPPINES	1	
GENERAL PRODZYNSKI	POLAND	10	10
GENIE	BAHAMAS	15	18
GIUSEPPE DI VITTORIO	UKRAINE	1	
GODAFOSS	ANTIGUA/BARBUDA	1	1
GRANT CARRIER	MALTA	2	
GREAT LAKER	MALAYSIA	7	8
GREEN ARCTIC	NORWAY	5	5
GREEN WATERS	CANADA	2	
GREENLAND SAGA	DENMARK	1	
GUDBORG	ICELAND	3	
HANDY MARINER	LIBERIA	10	7
HANDY TIGER	PHILLIPINES	1	1
HANS LEONHART	CYPRUS	4	2
HERCEGOVINA	MALTA	1	
HMCS GATINEAU	CANADA	5	
HMCS MONTREAL	CANADA	4	
HMCS NIPIGON	CANADA	1	
HMCS TERRA NOVA	CANADA	2	
HMCS TORONTO	CANADA	50	34
HMCS BRAVE	CANADA	1	
HOFSJOKULL	ICELAND	4	
HUBERT GAUCHER	CANADA	2	
HVILVTENNI	FAEROE ISLANDS	2	
HYPHESTOS	LIBERIA	5	
IGUANA	CYPRUS	3	
IMPERIAL ACADIA	CANADA	2	
IMPERIAL BEDFORD	CANADA	4	
INGRID GORTHON	SWEDEN	1	
IRENA ARCTICA	DENMARK	1	
IRVING ARCTIC	CANADA	1	
ITHAKI	CYPRUS	1	4
IVAN SUSANIN	RUSSIA	3	
IVAN TEVOSYAN	RUSSIA	1	
JIM KILABUK	CANADA	1	

* Sea Surface Temperature

Ship Name	Ship Flag	Ice Report	SST* Report
JO ELM	NETHERLANDS	3	
JOFUR	ICELAND	1	
JON GORTHON	SWEDEN	1	
JURIS AVOTS	LATVIA	1	
KAPITAN KUDLAY	RUSSIA	1	
KAPITAN ZAMYATIN	RUSSIA	1	
KAPITONAS A. LUCKA	LITHUANIA	7	4
KAPITONAS KAMINSKAS	LITHUANIA	5	
KAPITONAS STULPINAS	LITHUANIA	2	
KENT VOYAGEUR	BARBADOS	3	5
KOMMANDER AMALLE	ISLE OF MAN	2	
KONKAR INTREPID	GREECE	1	
LAKE CHAMPLAIN	PANAMA	10	
LAKE CHARLES	MALAYSIA	1	
LAKE MICHIGAN	MALAYSIA	2	
LAKE ONTARIO	MALAYSIA	1	
LAKE SUPERIOR	MALAYSIA	5	
LANDSORT	SWEDEN	9	9
LARINA	NORWAY	15	
LE QUEBECOIS	CANADA	1	
LE SAULE NO. 1	CANADA	1	
LEONARD J. COWLEY	CANADA	2	
LISKI	MALTA	8	10
LUCIEN PAQUIN	CANADA	4	
LYUBLINO	RUSSIA	2	
MALINSKA	MALTA	4	
MAPLE	BAHAMAS	1	1
MARGO REEFER	BAHAMAS	1	
MARINE RUNNER	CANADA	1	
MARJOLEIN	NETHERLANDS	2	
MARK C.	CANADA	1	
MATTHEW	CANADA	4	
MAURICE EWING	UNITED STATES	1	
MAXIM GORKIY	BAHAMAS	3	
MERCY VENTURE	CANADA	2	
MIKHAIL STREKALOVSKIY	RUSSIA	2	1
MING ZE HU	CHINA	5	6
MOR CANADA	CYPRUS	1	
MOR EUROPE	CYPRUS	2	
MOR U.K.	CYPRUS	4	
MUNKSAND	SWEDEN	11	6

* Sea Surface Temperature

Ship Name	Ship Flag	Ice Report	SST* Report
NAIN BANKER	CANADA	2	
NANDU	LIBERIA	7	
NATHALIE SIF	DENMARK	1	
NAUTICAS MEXICO	MEXICO	1	
NEPTUNE	LIBERIA	2	
NEWFOUNDLAND ALERT	CANADA	1	
NEWFOUNDLAND ARROW	CANADA	1	
NEWFOUNDLAND OTTER	CANADA	2	
NIKI	CYPRUS	2	
NIRJA	PANAMA	2	3
NOMADIC POLLUX	NORWAY	1	
NOMADIC PRINCESS	NORWAY	1	
NORD JAHRE PROGRESS	NORWAY	5	4
NORDIC CHALLENGER	NORWAY	2	
NORDIC EXPRESS	CANADA	1	
NORDOEN	SWEDEN	3	
NORTH STAR	LIBERIA	4	3
NORTHERN PRINCESS	CANADA	11	
NORTHERN WHALE	CANADA	1	
NUEVO LEON	MEXICO	1	
NUKA ARCTICA	DENMARK	1	
OAK	BAHAMAS	2	
OOCL ASSURANCE	HONG KONG	7	
OOCL BRAVERY	HONG KONG	7	
OOCL CANADA	HONG KONG	2	
ORAGREEN	BAHAMAS	2	
PAL MARINOS	CYPRUS	2	
PAOLA	PANAMA	1	
PATRIA	CYPRUS	2	
PETKA	MALTA	1	
PETROLAB	CANADA	2	
PHOENIX DIAMOND	PANAMA	1	
POMORZE ZACHODNIE	POLAND	21	19
PTARMIGAN	UNITED STATES	1	
REEFER EMPRESS	CYPRUS	1	
REEFER PENGUIN	JAPAN	1	
REGINA OLDENDORFF	HONG KONG	2	
RHODOS	GREECE	1	
RIXTA OLDENDORFF	HONG KONG	2	
ROMO MAERSK	DENMARK	1	
ROYAL MARINER	CANADA	1	

* Sea Surface Temperature

Ship Name	Ship Flag	Ice Report	SST* Report
SAGA SKY	PANAMA	9	9
SAN GIUSTO	ITALY	1	
SEAKOH	PANAMA	1	
SELNES	CYPRUS	2	
SIBYL W	CANADA	1	
SIDSEL KNUTSEN	NORWAY	3	
SIGURFARI	ICELAND	2	
SIR ELDON	CANADA	1	
SIR HENRY LARSON	CANADA	7	
SIR HUMPREY GILBERT	CANADA	18	
SIR JOHN FRANKLIN	CANADA	1	1
SIR ROBERT BOND	CANADA	3	
SREDAYA KOSA	RUSSIA	1	
STAKFELL	ICELAND	1	
STALIND I	NORWAY	1	1
STAR ALTANGER	SINGAPORE	3	1
STAR OHIO	LIBERIA	34	32
STRANGE ATTRACTOR	CYPRUS	11	7
STRONG ISLANDER	UNITED STATES	2	1
SUN P	GREECE	1	1
SUSAN	PHILLIPINES	2	
SUZANNE MARIE	UNITED STATES	1	
TAHKURAND	ESTONIA	1	
TELEOST	CANADA	7	
TELNES	PANAMA	3	
TITAN SCAN	NETHERLANDS ANT.	1	1
TOLEDO CARRIER	BAHAMAS	2	2
TORUNN HAUSTEEN	UNKNOWN	1	
TRIDENT MARINER	GREECE	1	
TRIESTE	ITALY	1	
TROGIR	MALTA		1
UNIWERSYTET WARSZAWSKI	POLAND	1	
VOK GBAY	UNKNOWN	1	
VYUGA	RUSSIA	3	
WAIMEA	GREECE	1	
WESTON	SWEDEN	3	
WILFRED TEMPLEMAN	CANADA	1	
WINONA	HONG KONG	3	
YPAPADI	PANAMA	1	
ZIEMIA SUWALSKA	POLAND	2	
SIEMIA TARNOWSKA	POLAND	3	

* Sea Surface Temperature

Ship Name	Ship Flag	Ice Report	SST* Report
ZIEMIA ZAMOUSKA	POLAND	9	9
TOTAL ICE REPORTS			899
TOTAL SST REPORTS			372

* Sea Surface Temperature

Appendix C

Limit-Setting Iceberg Report for 1996 Season

CDR Ross Tuxhorn and MST2 L. Scott Howell

Introduction

International Ice Patrol's mission is to identify the Limits of All Known Ice (LAKI) and to transmit this information to mariners at sea. During the ice season, the key element of IIP operations is to conduct reconnaissance patrols to determine the location of icebergs that establish the LAKI.

The LAKI is based on all known iceberg and sea ice information and represents the extent of iceberg danger in the vicinity of the Grand Banks of Newfoundland. From Newfoundland, the line marks the southwestern, southern, and southeastern limits of the iceberg region, and ends at an intersection point with latitude 52°N. Over the last twenty years, at its extremes, the LAKI has extended in the northwestern Atlantic Ocean as far south as latitude 39°N, and in the east to longitude 37°W.

Limit-setting icebergs are those icebergs that form the vertices of the LAKI. International Ice Patrol in recent years has collected data to learn more about these important icebergs. Analysis of this data has indicated the large relative contribution of sightings from IIP reconnaissance flights in this critical area near the limits.

The information pertaining to the limit-setting icebergs is important as a measure of effectiveness of IIP's surveillance efforts in locating the iceberg hazard. It is IIP's goal to continuously improve its mission performance by effectively locating the icebergs that constitute the LAKI and accurately provide this information to ships to enable them to avoid encountering icebergs.

Data Collection

Limit-setting icebergs were categorized as eastern, southern, and western by the side of the LAKI "polygon" where they occurred. For the majority of cases, the three categories of icebergs were distinct populations. The few exceptions were when icebergs drifted from the southern limit to the eastern limit. In those instances the iceberg's designation was changed accordingly.

Data on the limit-setting icebergs were gathered daily from the output of the Iceberg Data Management and Prediction System (DMPS). Icebergs were recruited as limit-setters either from the 1200Z Ice Bulletin list of "icebergs not in area of many bergs" or from iceberg sightings by the various sources at or near the LAKI. Each day, the icebergs in the limit-setter database were accounted for. The attributes of those icebergs were checked to ascertain any resights or deletions, and any changes were recorded. The following information was determined for each of the designated limit-setting icebergs:

1. DMPS iceberg number.
2. Days on plot in DMPS model.
3. Days as a limit-setting iceberg.
4. Source of sighting when entered in limit-setter database, and any subsequent resighting source.
5. Location on LAKI — W, S, E.
6. Method of deletion: Collection of data on a given limit-setting iceberg ended when it was deleted from DMPS by standard IIP criteria. There are two ways by which IIP removes an iceberg from DMPS:

a. The iceberg deterioration model predicted the iceberg has melted (Anderson, 1983).

b. The area around the predicted position of the iceberg has been thoroughly searched either through visual or double radar coverage.

Discussion

During the 1996 season, 110 icebergs determined the LAKI. Table 1, lists the sources of the limit-setting icebergs when they were initially sighted, or first entered into the iceberg drift model, and when they were last sighted in the area of the LAKI. As in the previous season (Tuxhorn and Krein, 1995), the table shows that IIP reconnaissance was the primary contributor of icebergs that eventually established the LAKI and the major sighting source of the icebergs prior to their melting completely and removal from the model.

Table 1
Sources of LAKI Icebergs

Sighting Source	Initial Report (% of Total)	Final Report (% of Total)
Coast Guard (IIP)	61	57
Other Air Recon (GPCD)	7	11
Canadian AES (GCFR)	8	8
Ships	20	20
BAPS	2	2
Other	2	2

Table 2, shows the initial sighting sources for the three categories of icebergs: western, southern, and eastern limit-setters. Examination of the numbers reveals that IIP provided the majority of the sightings on all three sides of the LAKI. Ship reported limit-setters were mostly near the eastern and southern regions. And, iceberg reports from Canadian AES (GCFR), Other Air Recon (GPCD), and BAPS contributed a combined number of limit-setting icebergs roughly equivalent to the number provided by ships.

Table 2
Initial Iceberg Sighting Sources With Respect to LAKI Region

Sighting Source	LAKI Icebergs West	South	East	Combined Count
Coast Guard (IIP)	11	23	33	67
Other Air Recon (GPCD)	2	4	2	8
Canadian AES (GCFR)	0	4	5	9
Ships	2	8	12	22
BAPS	0	0	2	2
Other	2	0	0	2
				110

The size distribution of the limit-setting icebergs, as reported by the final sighting source, is displayed in Table 3. Over half of the sightings were reported as "general sized icebergs", which is the unspecified size used for the most part to indicate icebergs detected by IIP radar surveillance only.

Table 3
Size Distribution of LAKI Icebergs

Size Category	% of Total
Growler	8.2
Small	16.4
Medium	9.1
Large	10.9
Very Large	0.9
General	54.5

Again this season, the study showed that IIP's melt model is very important as a tool for maintenance of the LAKI . From Table 4, 68% of the limit-setters were deleted after reaching 150% melt. Non-detection of icebergs during reconnaissance patrols accounted for 32% of the deletions, of the icebergs that comprised the LAKI. The reader is directed to the IIP Organization and Procedures Manual (CIIPINST M5400.1) for the policies pertaining to deletion of icebergs from the model.

Table 4
Deletion Method of LAKI Icebergs

Method	% of Total
150% Melt	68
200% Radar Coverage	20
Visual Recon Coverage	12

Conclusion

The results from this work have yielded a better understanding of the contributing surveillance sources and the final fates of the limit-setting icebergs. In the 1996 Season, 3902 icebergs (including resights) were entered in the IIP iceberg drift models, of which 110 were used to set the LAKI. For comparison, in the 1995 Season, 7962 icebergs were entered in the IIP iceberg drift model, of which 144 became limit-setters. Assuming data from these two years are typical, then the great majority of icebergs, which pass south of 52°N latitude or are detected in the IIP operations area, melt before they ever approach near the LAKI.

This season's study reinforced a finding of the 1995 study, that approximately half of the limit-setting icebergs are detected by IIP reconnaissance. In 1995, 48% of the limit-setting icebergs were initially detected by IIP patrol flights conducting reconnaissance patrols near the limits. For the 1996 season, IIP patrols accounted for 61% (Table 1) of the initial sightings of limit-setting icebergs. Most of these detections ocurred near the LAKI, which means these icebergs either make it through the IIP operations area (from 52°N to LAKI) undetected or are created in the region near the LAKI. If the latter is considered, it suggests that the splitting of icebergs into "pieces" as they journey south, and especially in the vicinity of the LAKI, is an important process of their deterioration. Regardless of how they get there, the fact that these icebergs are found at the LAKI gives impetus for IIP to remain vigilant in this region.

References

Anderson, I., 1983, "Iceberg Deterioration Model", Report of the International Ice Patrol in the North Atlantic, 1983 Season, (CG-188-38), pp. 67-73.

Tuxhorn, R.L. and T.T. Krein, 1995, "Analysis of Limit-Setting Icebergs", Report of the International Ice Patrol in the North Atlantic, 1995 Season, (CG-188-50), pp. 45-53.

Appendix D

Analysis of IIP Reconnaissance Results

CDR Ross Tuxhorn and MST3 Tristan T. Krein

Introduction

International Ice Patrol provides a seasonal service of iceberg patrols when the presence of icebergs threatens the North Atlantic shipping routes in the Grand Banks region. Information concerning iceberg conditions near the limits of all known ice is collected primarily from air surveillance conducted by IIP.

IIP reconnaissance data, as well as iceberg reports from other sources, is fed into the iceberg drift and deterioration computer models along with ocean current and relevant environmental data. Every twelve hours, the computer models use this information to estimate the iceberg positions and determine the limit of all known ice (LAKI). This limit is then broadcast as an ice bulletin and facsimile chart for the benefit of all ships transiting the ocean routes between Europe and North America.

In 1995 and 1996 data were compiled on the results and effects of iceberg patrols conducted in those seasons. This information provides a useful gauge of the effectiveness of IIP reconnaissance efforts and the accuracy of the drift and deterioration models.

Data Collection

Data on iceberg detections, iceberg deletions, and changes to the LAKI from iceberg patrols in 1995 and 1996 are shown in Tables 1 and 2. The iceberg detection numbers (icebergs, growlers, and radar targets) were taken from the flight messages which report the results of each iceberg reconnaissance flight. There were forty five (45) and forty six (46) patrol flights in 1995 and 1996, respectively. The number of icebergs deleted as a result of each patrol was derived from the process of merging the patrol information into the iceberg computer database. Iceberg deletions from the database involve duty watch officer decision making within parameters set down in "Standing Orders For IIP Operations Center Duty Personnel" (CIIP Instruction M3120B). "Change to LAKI" was determined by simple comparison of the limits before and after the reconnaissance information was merged into the model and calculation of the area (square nautical miles) added or subtracted by the adjustments to the LAKI.

Discussion

The average number of total iceberg detections per patrol in 1995 was 54 and in 1996 was 19. The difference in these annual averages probably relates to the annual flux of icebergs across 48°N; in 1995, 1432 icebergs crossed 48°N while in 1996, 611 icebergs crossed that latitude. It is also important to realize that the variation in iceberg sightings from one patrol to the next is a function of the geographic location of the patrol area; patrols near the LAKI usually yield small counts while patrols farther north result in higher numbers of detections.

For each of the seasons, the average number of deletions per reconnaissance flight was 7 in 1995 and 11 in 1996. Deletions of icebergs occur when an area is surveyed with acceptable visibility or radar coverage and the patrol does not find icebergs near the predicted position.

Figures 1 and 2 show the change of ocean area (nm^2) affected by the limits as a result of reconnaissance effort. Increases in area indicate iceberg detections close to or outside the LAKI. Conversely, area decreases are the result of an absence of icebergs at predicted locations. The ice reconnaissance flights are the primary means for ascertaining the accuracy of the iceberg limits.

It is IIP's supposition that a zero change in the LAKI as a result of reconnaissance effort indicates proficient model performance. In the data of both years, there is an apparent feature of greater LAKI shifts with associated negative changes in influenced area in the later part of the patrol seasons. This suggests for this phase of the season when the iceberg deterioration rate is greatest the inability of the IIP models to keep pace with the fast changing iceberg conditions. Furthermore, it reveals — in addition to locating the limit setting icebergs — the function of reconnaissance patrols as corrective devices to minimize the area of ice free ocean contained within the LAKI.

Table 1

1995 IIP SEASON								
							Change to	
FLT	Date	IRD	Icebergs	Growlers	Radar	Deletes	LAKI nm^2	Remarks
3	02/24	1	0	3	0	4	0	
4	02/26	1	2	0	0	2	0	
5	02/27	1	9	6	0	4	0	Season Start 2/28 00Z
6	03/15	2	107	12	18	7	10,800	SW LAKI / 1 Berg o/s LAKI
7	03/17	2	17	1	7	41	0	
8-9	03/20	2	8	0	18	2	-6,000	S LAKI
10	03/21	2	25	12	3	6	0	
11	03/30	3	61	12	2	8	0	
12	03/31	3	2	0	0	3	0	
13	04/05	3	9	0	0	6	3,400	S LAKI / 2 Bergs o/s LAKI
14	04/13	4	12	0	1	6	-13,000	S LAKI / 1 Radar o/s LAKI
15	04/14	4	3	0	0	0	0	
16	04/17	4	56	2	0	6	2,100	E LAKI
17	04/19	4	6	1	0	10	0	
18	04/26	5	3	0	2	12	0	BergSearch
19	04/27	5	6	4	0	10	7,400	E LAKI
20	04/28	5	9	5	0	2	-6,000	W LAKI
21	04/30	5	0	0	0	0	0	BergSearch
21	04/30	5	515	203	0	0	0	Woce Buoy Drops **Note 1**
22	05/01	5	0	0	0	0	0	BergSearch
22	05/01	5	449	44	0	25	0	**Note 1**
23	05/02	5	3	0	0	0	0	BergSearch
24	05/10	6	2	0	0	2	7,400	S LAKI
25	05/12	6	36	2	6	1	-2,900	S LAKI
26	05/13	6	67	9	6	27	25,400	S LAKI
27	05/15	6	9	0	0	4	0	Buoy Drop
28	05/17	6	8	0	0	29	0	
29	05/26	7	1	0	0	0	0	INS Inop / SAR Divert
30	05/27	7	9	8	6	0	0	
31	05/29	7	10	0	2	0	-25,400	SW LAKI
32	05/30	7	44	0	2	0	0	Buoy Drop / SAR Divert
33	06/01	7	130	210	33	1	7,700	W LAKI
34	06/08	8	1	5	4	9	-4,800	S LAKI / Good Vis
35	06/09	8	8	2	2	50	-25,200	W LAKI / Good Vis
36	06/12	8	0	0	2	6	0	Good Vis / 30nm Track Space
37	06/23	9	52	32	4	4	12,200	SW LAKI / 2 Brg, 1 RT o/s LAKI
38	06/24	9	7	2	0	1	0	30nm Track Space
39	06/25	9	1	0	13	0	0	50nm Track Space / No Vis
40	06/26	9	3	9	0	10	-8,300	SE & SW LAKI
41	07/11	10	0	0	5	1	0	5 RTs S of LAKI in 15 Deg C
42	07/14	10	0	0	0	10	-16,900	W LAKI
43	07/15	10	21	0	0	0	0	SAR Divert
44	07/17	10	2	0	0	0	0	High Seas
45	07/27	11	0	0	0	2	-14,300	S-SW LAKI / Season Close 8/1
	Totals:		***1713***	***584***	***136***	***311***	***-1,031 (average)***	

Note 1: The large number of icebergs and growlers reported by these reconnaissance flights were later found to be sea ice fragments. These targets were not merged into IIP's database.

Table 2

1996 IIP SEASON								
							Change to	
FLT	Date	IRD	Icebergs	Growlers	Radar	Deletes	LAKI nm^2	Remarks
1	01/26	Pre	21	1	1	0	0	Preseason Recon
2	02/28	1	8	0	5	0	0	
3	03/01	1	0	0	0	6	0	Woce Buoy Drop
4	03/02	1	18	3	0	3	0	Woce Buoy Drop
5	03/14	2	0	0	0	6	-14,600	S LAKI / Season Start
6	03/15	2	0	0	0	8	-32,500	S LAKI
7	03/16	2	6	0	0	1	0	
8	03/29	3	0	0	0	0	0	
9	03/30	3	49	0	0	0	5,400	S LAKI
10	04/01	3	217	0	0	38	5,700	E LAKI
11	04/10	4	5	0	0	0	0	Transit in Patrol
12	04/12	4	5	0	4	0	0	Titanic Patrol
13	04/13	4	6	0	8	10	0	Buoy Drop
14	04/14	4	46	0	1	102	0	Buoy Drop
15	04/17	4	25	3	3	6	3,000	SW LAKI
16	04/25	5	6	0	0	6	0	
17	04/26	5	4	0	0	13	-8,000	SE LAKI
18	04/27	5	48	0	0	4	0	
19	04/28	5	9	0	0	0	0	Buoy Drop
20	04/30	5	27	0	0	20	0	
21	05/01	5	11	0	0	12	6,900	S LAKI
22	05/10	6	5	0	0	32	3,300	SW LAKI
23	05/14	6	5	0	0	5	12,300	SW/SE LAKI
24	05/16	6	7	0	0	15	0	
25	05/17	6	29	4	0	11	0	
26	05/18	6	0	0	0	1	-15,300	SW LAKI
27	05/23	7	0	0	0	3	0	
28	05/24	7	7	0	0	22	0	Short FLT (WX)
29	05/25	7	3	0	0	1	0	Short FLT (WX)
30	05/26	7	9	0	0	34	-21,900	E LAKI
31	05/27	7	5	0	0	16	-2,800	S LAKI
32	05/28	7	20	0	0	10	7,500	W LAKI
33	06/06	8	3	0	1	2	-22,500	S LAKI
34	06/07	8	3	0	0	11	-19,300	W LAKI
35	06/08	8	2	0	0	2	-1,400	S LAKI
36	06/09	8	4	0	0	11	-3,400	SE LAKI
37	06/21	9	13	0	6	5	3,300	E LAKI
38	06/22	9	7	2	1	8	0	Buoy Drop (No Chute Deploy)
39	06/23	9	4	0	0	10	-20,700	S LAKI
40	06/24	9	45	68	0	35	0	Buoy Drop (No Chute Deploy)
41	06/25	9	2	0	3	0	0	
42	07/09	10	0	0	0	2	-44,100	S LAKI / No Ice Below 45N
43	07/10	10	0	0	5	2	-18,400	E LAKI
44	07/13	10	49	0	0	13	0	N-W Survey
45	07/14	10	1	0	3	4	-23,300	S LAKI / Checked Ship Report
46	07/16	10	4	12	0	0	-13,000	E LAKI
		Totals:	*732*	*93*	*41*	*490*	*-4,648 (average)*	

Figure 1

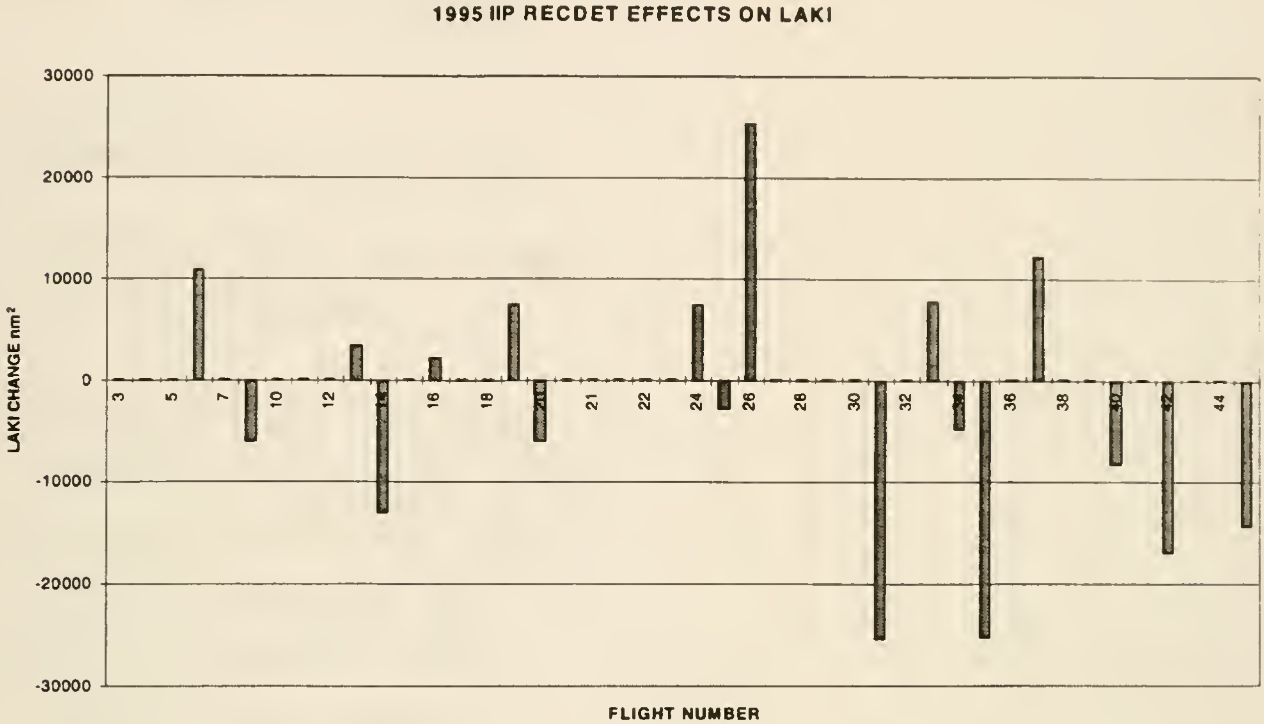

Figure 2